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Featuring

History of Division of Waterways and Public Lands, Massachusetts Department of Public Works

Chlorination of Water and Sewage

Annual Reports

Vol. XIII No. 4

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ADDRESS AT THE ANNUAL MEETING

BY RICHARD K. HALE,* PRESIDENT, BOSTON SOCIETY OF CIVIL ENGINEERS

(Presented March 17, 1926)

A Brief History of the Development of the Division of Waterways and Public Lands of the Massachusetts Department of Public Works

THE original title to New England Lands was in the English Crown, which claimed it by right of discovery and possession, and it passed by grants made by the Crown to several companies.

The early grants or charters were to trading companies, and conveyed only a fee in the soil with no right of government. In 1627 the Plymouth Company granted the fee in a strip of land extending three miles north of the Merrimack River and three miles south of the Charles River to Sir Henry Rosselle and five associates, and on March 4, 1628/29, Charles I granted to Sir Henry Rosselle and twenty-five associates a royal charter confirming the title and creating therein a body corporate and politique in fact and name, to be known as the Governor and company of Massachusetts Bay in New England, and they settled and governed Massachusetts Bay Colony, including the "lande upon the mayne and . . . the islands and seas adjoining".

The grantees, therefore, had a complete and independent system of government and ownership over the lands, harbors, rivers and shores, with the same power of disposing of their ownership as had any owner in England.

The Plymouth Colony had no right to govern itself at any time. In 1691 the Bay Colony received a new charter, creating it a royal province and extending its jurisdiction over what is now Massachusetts

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and Maine; Nantucket, Marthas Vineyard and adjacent islands being annexed from New York at the same time.

It was generally considered that the Indian had no fee in the lands because of his constant migration. His right of occupancy was generally extinguished by the colonists who received the grants.

Under the common law of England the Crown or sovereign actually owned all the shore between high and low water and all creeks and coves and other areas of the sea where the water ebbs and flows. He could, however, dispose of rights in these areas to private persons.

Charles I was particularly active in disposing of these shore rights, and in a manner so distasteful to the owners of the adjoining upland that these acts formed one of the causes of his indictment.

The early settlers in Massachusetts were so impressed with the trouble that the public ownership of this shore property might cause that they granted it to the owners of the upland, reserving, however, certain public rights therein. This act also was occasioned by the desire to encourage the building of wharves by private parties. At the same time all ponds which contained in their natural condition more than ten acres of land were reserved from future grants, and the free right of fishing and fowling therein was held for the public.

This ordinance is of such interest at the present day, when the public is making increasing demands for the free use of the ponds and beaches, that it is of value to present that section of the Colony Ordinance of 1641–49, or, as it is sometimes called, the Body of Liberties.

Every inhabitant who is an *householder* shall have free fishing and fowling in any great pond, bays, coves, and rivers, so far as the sea ebbs and flows within the precincts of the town where they dwell, unless the free men of the same town or the General Court have otherwise appropriated them. Provided that no town shall appropriate to any particular person or persons any great pond containing more than ten acres of land, and that no man shall cross upon another's propriety without their leave otherwise than as hereafter expressed. The which clearly to determine: it is declared, that in all creeks, coves, and other places, about and upon salt water where the sea ebbs and flows, the proprietor of the land adjoining shall have propriety to the low water mark, where the sea doth not ebb above a hundred rods, and not more wheresoever it ebbs further. Provided that such proprietor shall not by this liberty have power to stop or hinder the passage of boats or other vessels, in or through any sea, creeks, or coves to other men's houses or land. And for great ponds lying in common, though within the bounds of some town, it shall be free for any man to fish and fowl there, and may pass and repass on foot through any man's propriety for that end, so they trespass not upon any man's corn or meadow.

This ordinance invested the ownership of the flats in the owners of the upland in fee, to be held subject to the general rights of the public

enumerated until built upon or enclosed, but provided such structure should not impede the passage of vessels. The King, and after the Revolution the State, reserved control over the shores of the sea and the waters for the protection of the rights of navigation.

It is interesting to note that no recreational rights, such as bathing, were reserved in the shores or beaches.

Apparently any one placing wharves or filling on his flats did so at his peril, and was liable for indictment if he interfered with navigation or with the means of access to another's land. There was no general law providing for licenses for such work until 1872, though there were, of course, many special laws covering individual structures, or structures in particular localities.

The right to grant land was vested in the General Court, and grants were made either to individuals as rewards for services or to promote some special commercial undertaking, or to groups, who became known as proprietors, for the formation of new plantations or towns, under conditions which had to be met or the grant forfeited. The actual location of these grants was under the careful supervision of a committee of the General Court appointed for the purpose.

These proprietors in turn made grants to the individual members of the group, but in many places certain lands apparently were retained for common use of the proprietors. The question as to whether or not the towns are the legal representatives of these proprietors and now own these ungranted parcels is of great interest at the present time.

The question of the disposal of the land remaining in control of the State became of great interest during and just after the Revolution, and many petitions were brought before the Legislature for grants. These grants were made as before, either to groups for settlement or to individuals, usually under direction of a committee appointed by the Legislature from among its own members.

The public domain consisted at that time of considerable areas in the western part of the State, considerable tracts in New York and large areas in Maine.

In 1781 a resolve was passed appointing a committee to examine into the status of all unappropriated lands belonging to the Commonwealth and giving therein wide powers to eject trespassers and oppose illegal entries.

This law is of considerable interest as it is the first law found that gave such broad powers to a committee invested with general authority, and certain of its provisions have been continued to the present time.

In 1783 another committee was appointed to examine into the lands

in the Eastern Counties (Maine), principally Lincoln County. Thereafter these two committees appear to be merged, and are known as the Committee on Eastern Lands.

A considerable impetus was given by Governor Hancock in his message in 1787 urging the development and sale of these lands to aid in meeting the heavy war debt under which the State was laboring.

In 1801 the policy changed, the committee was discharged and two agents were appointed to carry on the work.

After the War of 1812 a new impetus was given and many grants were made to returning soldiers. A report made in 1813 of an investigation into existing conditions is interesting as it gives the first idea of the magnitude of the State's holdings. It appears that from 1791 to 1813 nearly four million acres had been sold for an average of about 28 cents per acre, and that it was thought that there were nearly eleven million acres left, largely around Kennebec and Penobscot rivers. The committee which made this report believed that the management was not suitable and recommended that the organization be changed.

This was confirmed by another investigating committee in 1816, which reported that there were sixteen million acres of land available for sale. Accordingly, in 1816 a land office was established, in charge of three agents to be appointed by the Governor, who was also to appoint a surveyor general who, under the supervision and direction of the commissioners, was to make the necessary plans and surveys.

In 1819 an act was passed creating, subject to congressional authority, the Province of Maine as a separate State, but retaining for Massachusetts, tax exempt, its title to one-half the public lands. Commissioners were appointed to supervise the apportionment of these lands.

In 1820 (Resolves, chapter 24) the land agents were discontinued and a single agent appointed to continue the duties until further ordered, and in 1823 (Resolves of 1822, chapter 47), this agent was authorized to act with the state treasurer in selling the land.

The next thirty years was a period of considerable excitement and land speculation, and large areas were sold.

In 1850 trouble arose, and a special committee consisting of the state secretary, treasurer and auditor was appointed to confer with the land agent, who was directed not to sell any more land without its authority, and another investigation ordered. Reports at this time showed that there were about two million acres left belonging to the State.

In 1852 the Legislature directed that all the land be sold, and bids were called for the purchase of about one and one-half million acres.

The highest bid was at the rate of about 43 cents per acre. As the sale was to private parties, the State of Maine, which had been a bidder, raised considerable objection, and the Governor and Council refused to approve the sale. Matters were adjusted, certain areas were reserved for townships, a large tract was sold to the State of Maine, and the remainder sold to the highest bidder. The terms were on the basis of a 10 per cent deposit, the balance to be paid in twenty annual installments.

In 1858 the land office was abolished, to take effect on January 1, 1859, and its duties transferred to the state treasurer and receiver general. The act was repealed, however, in the following year, and by chapter 103 of the same year the land agent was given charge of all lands, flats, shores and rights in tidewater belonging to the Commonwealth, except in the Back Bay. This was certainly wide authority, but as no appropriation was ever made not very much work was done. In the same year a committee made an interesting report on certain claims arising from the sale.

In 1861 the office of the land agent was abolished and all duties and records were transferred to the Commission on Public Lands.

Early Development of Boston Harbor

In 1835 a commission of three members was appointed to survey a portion of Boston Harbor and determine the expediency of establishing a harbor line beyond which wharves could not be extended. Their report gives a good description of the methods used in making the survey and of the harbor lines chosen, with many interesting comments about the probable damages to the channels if proprietors were allowed to encroach on the flats and if the various milldams contemplated should be built. This report resulted in the harbor line of 1837, with the provisions that no wharf be extended beyond the line and that no ashes be dumped in certain parts of the harbor.

In 1839 another commission of three was appointed to study the report of 1837 to determine the expediency of adopting portions of the proposed harbor line that had not been adopted. It expressed the belief that the demand for filling of flats to create land for the growth of the city was more pressing than the need for more water accommodations. Several additions to the harbor lines that it recommended were adopted by the Legislature.

In 1845 (Resolves, chapter 109) a commission was appointed to make extensive surveys in the South Bay and up the Charles and Mystic rivers.

In 1846 a commission of three was appointed to examine the portion of the flats in Boston Harbor off South Boston with a view of determining whether any improvement could be made which would be beneficial to the commerce of Boston Harbor. Its report (1847) included a plan of that portion of the harbor, and the line of riparian ownership in South Boston. This commission recommended that a wall be built along the Fort Point Channel and along what is now the main ship channel so as to control the scour of the current, and expressed the belief that the flats could be filled without any danger of damaging the harbor by shoaling. This report is of considerable interest as it outlined the filling of the South Boston flats substantially as finally completed, but did not present any definite plans therefor until the legal matters could be determined.

In 1848 a commission of five was appointed to consider the rights and duties of the Commonwealth in relation to the flats and the extent of any filling that should be undertaken. This commission rendered a lengthy report in 1850 (Sen. doc., Nos. 8 and 119), in which they discussed the many legal points involved, reviewed the reports of the previous commissions, and expressed the opinion that no encroachment should be permitted on the Charles or Mystic River, and that all encroachments in tidewater should be controlled by law. A partial filling of the South Boston flats was approved upon a somewhat fanciful plan. The filling of certain flats in the Mystic River was approved under proper control (this was authorized in 1852). The filling of the Back Bay was also discussed, and it was presented that the legal rights should be considered and a proper settlement reached between claimants, and that the Legislature should hold all flats and not release them for filling until the record was thoroughly established.

In 1848 a resolve was passed directing prosecutions for violations of the acts establishing the harbor lines, and indictment was found. The Supreme Judicial Court rendered its opinion in 1853 (Commonwealth *v.* Alger) supporting the constitutionality of the harbor lines even where they limited the construction of wharves on private flats.

In 1850 a commission of three was appointed to further study harbor lines and the question of filling in the Back Bay. It made a preliminary report in 1851 (House doc., No. 106), in which it held to the opinion that the State owned the flats, and recommended the filling of those in South Boston, though not to the extent recommended in previous reports.

In 1852 (Sen. doc., No. 45) the commission presented its final report, in which it discussed the filling of the Back Bay, presenting a careful study of the grants that had been made and the ownerships involved

and referring to various studies the city of Boston had been making. The commission recommended that the State should authorize the parties at interest to fill the flats with clean gravel. It recommended that a commission be appointed with broad powers over all the flats in Boston Harbor and the enforcement of laws regarding them.

In response to this report the Legislature provided for the appointment of the commissioners for Boston Harbor and the Back Bay (Resolve of 1852, chapter 79), with full powers to determine and settle the ownership in the basins and to devise or adopt a plan for filling and improving them. Numerous other acts were passed in this connection enlarging and defining the powers of the commission. In 1855 its name was changed to the Commissioners on the Back Bay, and in 1861 the land office was abolished and its duties handed to this commission, the name of which was changed to the Commission on Public Lands.

This commission carried out its difficult legal problems and completed the filling of the Back Bay, laid out and constructed the streets and sold most of the land. It was reorganized in 1877 (chapter 213) to a board of three commissioners, combining the powers and duties and continuing the work of the Commissioners of Public Lands and that of the agents appointed in 1875 (chapter 239) in relation to the South Boston flats, and in 1879 this new commission was abolished and its duties transferred to a new board of three commissioners, known as the Harbor and Land Commissioners. It transferred to the new board about 400,000 square feet of land in the Back Bay, with a profit on that work of nearly two million dollars, and in South Boston about 750 acres of flats partly filled, representing a net construction cost to the State of a little less than eight hundred thousand dollars.

Boston Harbor

We have seen that in 1855 the name of the Boston Harbor and Back Bay Commission was changed by omitting the Boston Harbor part of the title but without any change in the prescribed duties. This was possibly because of the fact that in 1854 there was passed a resolve providing for the appointment of three commissioners to study the flats on the Mystic River and to continue the harbor lines in East Boston and South Boston. The report was made in 1855 (Sen. doc., No. 63), and in it the commissioners considered the general conditions of the harbor and rivers, called attention to the great value of tidal scour in maintaining channels, and recommended that the tidal volume be conserved by requiring that compensation should be made for all areas

filled by dredging an equal volume elsewhere. They believed it was most important to appoint a permanent board which would have jurisdiction over the harbor. They recommended asking the Federal government to appoint a board to study the harbor and make recommendations in regard to its improvement.

The city of Boston became much interested in the preservation of the harbor, and in 1854 requested the Federal government to appoint a board to consider the subject. A board was designated consisting of the chief of engineers, the superintendent of the Coast Survey and a naval officer. It made many important investigations and studies, comprised in a series of ten reports. The board ceased to function on the appointment of the Harbor Commissioners in 1866.

The State appointed a Commission on Harbors and Flats, three commissioners, in 1862 (chapter 88) who were to co-operate with the government board in their studies, and to devise and report a general and economical system for the care and preservation of the harbors of the Commonwealth and the use and development of the flats therein, with special attention to South Boston and the South Bay.

This commission, although temporary in character, was authorized in 1864 to establish harbor lines in any harbor of the Commonwealth. Acting under this authority harbor lines were established in Gloucester in 1865 which were confirmed by the Legislature in 1866. It was also empowered to prescribe the mode of extending the wharf of the Fitchburg Railroad.

This series of reports is most interesting. The commissioners made studies of tides and currents and the effects of structures on shoaling in the channels, and was responsible for many of the early surveys.

It is because of their efforts that most of the work of protecting the islands in the harbor was first undertaken. It was the first time that any real scientific study was carried on in a connected way over a period of years. They early came to the conclusion that the upper part of the harbor was kept clean by the tidal flow in the Mystic and Charles rivers, and that the spreading out of this flow over the South Boston flats resulted in causing shoaling in the channel. They therefore recommended in the strongest language that a diverting wall be constructed, extending from Fort Point Channel towards Castle Island, so as to prevent this spreading of the stream. They opposed any diminution of the river — even the use of Mystic Lake as a water supply.

The building of this wall was a most popular idea as it would enable a large area of flats back of this wall to be filled, but the commissioners hastened to declare that this area could be filled only if pro-

vision were made by dredging the flats on the Charles and Mystic rivers in order to compensate the volume of tidewater displaced.

It was this idea of proper compensation for all filling, so vigorously supported by this board and its followers, that caused so much controversy in succeeding years and which was finally discredited.

The recommendations of these two boards were adopted, and in 1866 (chapter 149) the Board of Harbor Commissioners, with five members, was appointed. This board had the general supervision and care of all the harbors, tidewaters and flats, and lands flowed thereby, except the Back Bay lands, with power to prevent and remove unauthorized encroachments which would hinder navigation or cause any reduction in the tidewater. It was to pay special attention to the riparian rights in the South Boston flats, and to prepare a plan for their improvement.

The board was authorized to make any recommendations in regard to harbor lines in any harbor. It also had jurisdiction over any structures authorized by law, and could approve or disapprove the plans therefor. The act required persons encroaching in the tidewaters to make suitable compensation therefor, either by dredging or by paying suitable sums, which were to be set aside for dredging in the harbor where the structure was built.

By a later resolve of the same year (chapter 81) the Legislature approved the plan proposed by the previous board for the construction of the sea wall, and directed the board to make plans and estimates therefor.

This board appointed an advisory council, consisting of the superintendent of the United States Naval Observatory, the chief engineer, U. S. A., another engineer officer and Mr. Harvey Mitchell of the United States Coast Survey. Albert Boschke was appointed chief engineer of the board.

In the following year (1867) the board was authorized to make a contract for the construction of the sea wall. A state engineer entirely independent of the board was appointed to prepare the plans and specifications of the wall and supervise its construction. Mr. George R. Baldwin was appointed to this position and has the distinction of having been the only state engineer. The honor was short lived, however, as the position was abolished in 1868.

The board succeeded in obtaining appropriations from Congress for removing obstructions from the main ship channel and for the construction of sea walls along exposed headlands.

The board objected to the recommendation of erecting reservoirs to compensate the filling, to be placed back of the proposed wall, and

made the reasonable proposal that it would be much cheaper to dredge out the channels and place the dredged material in the fill. It expressed the belief that the cost of maintaining these channels would be much less than the cost of compensating for the fill.

The Legislature appointed a committee of nine in 1867, with full power to contract for the construction of the sea wall and to make arrangements for the construction, the payments therefor to be made in land or flats. This committee reviewed the situation but took no action. Another committee was appointed by the House in 1868 which made a vigorous report, strongly advising the filling of all flat areas to provide for the growth of the city, and decrying any statement that such filling could possibly damage the harbor. It also recommended that the Harbor Commissioners and Land Commissioners be consolidated.

In 1868 the Legislature authorized the board to construct the wall and to fill back of it, an appropriation of $200,000 was made available to meet part of the cost, the remainder to be met from the sale of lands.

There were considerable legal difficulties encountered in acquiring the rights for some of the areas concerned, but agreements were finally made with the Boston Wharf Company and the Boston, Hartford & Erie Railroad and the Boston & Albany Railroad whereby transfers and sales were accomplished and the construction of the wall and the filling started in 1869. It is interesting to note that some of this filling was taken from Fort Hill, which was being reduced at that time.

In 1872 the important power to license structures in tidewater was granted to the board, and in 1874 this power was broadened and charges provided for the rights and privileges granted in land belonging to the Commonwealth beyond the line of riparian ownership.

In the next few years the legal matters were straightened out, agreements reached and the construction work continued, both on the retaining walls and on the filling, and streets began to appear.

The board was giving a good deal of attention to other harbors in the State, large sums had been spent by a special commission at Provincetown and the care of the work turned over to this board. During this period the Federal government spent considerable sums on breakwaters and dredging in the smaller harbors, and this board was cooperating in such work.

In 1874 the Legislature appointed a special committee to consider the interest the Commonwealth had in the development of the South Boston flats. This committee reported, in the following year (House doc., No. 100), that this large area should be developed under a

comprehensive plan for commercial uses and for additional railroad terminal facilities.

This report resulted in the appointment (1875, chapter 239) of a new board of three commissioners, known as the Agents of Commonwealth Flats, to make a plan for the commercial development of this area, relieving the Harbor Commissioners of any further responsibility in the matter. The latter board continued its general work on other

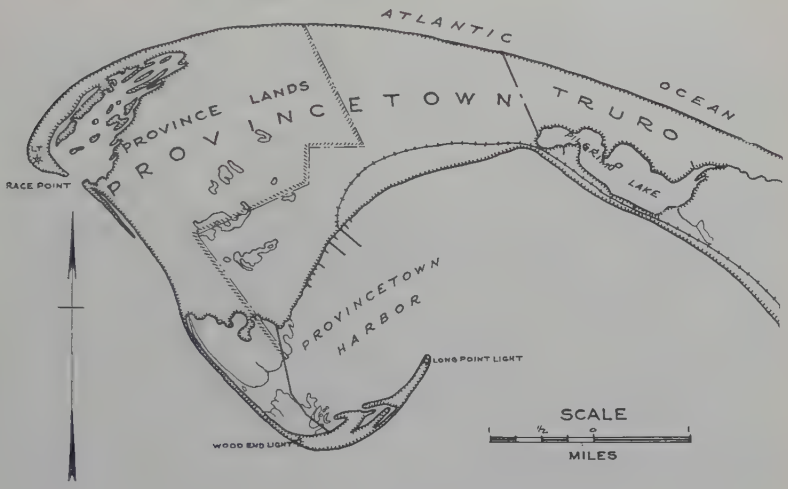

FIG. 1. — MAP OF PROVINCE LANDS

The Province lands were bought from the Indians in 1654. The township of Provincetown was created in 1727 and its inhabitants granted the same rights possessed by inhabitants of any town except the ownership of the land which remained in the Province. In 1893 a line was established dividing the lands, and restrictions against acquiring title by twenty years' occupancy were removed for that portion lying east and south of the established line. The portion lying west and north of the line was placed in charge of the Harbor and Land Commission. On this area squatters cannot acquire rights

matters. It was reorganized into a board of three commissioners in 1877 (chapter 213) but no changes were made in its functions.

This new board of agents accomplished little, and in 1877 (chapter 213) it was combined with the Commissioners on Public Lands, forming the new board of Land Commissioners.

In 1879 (chapter 263) the Land Commissioners and the Harbor Commissioners were consolidated into the new board of three, called the Harbor and Land Commissioners, with the combined duties of the two boards.

The duties and responsibilities were gradually increased, and more and more funds were placed at its disposal. In 1881 the board was directed to extend town boundary lines from high water to the exterior line of the Commonwealth.

The care and supervision of the Connecticut River was added in 1885 and great ponds in 1888. The non-tidal parts of the Merrimack River were placed under the supervision of the board in 1914.

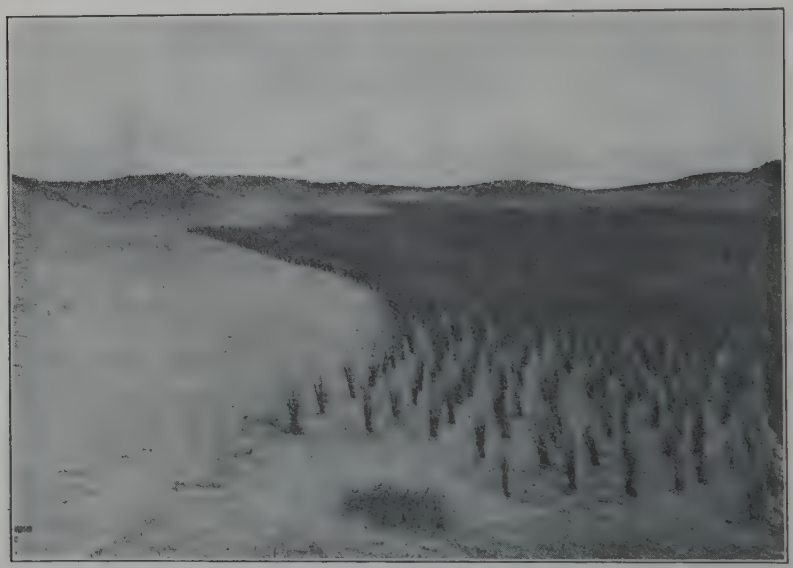

FIG. 2. — BEACH GRASS PLANTED ON PROVINCE LANDS

On the destruction of trees, brush and beach grass the sand drifted into the harbor and threatened serious shoaling. Between 1826 and 1838 the Federal Government spent considerable sums in planting beach grass to prevent movement of the sand. This work has been carried on by the State. Dead brush is placed over areas where grass cannot grow without such protection. Many kinds of trees as well as shrubs, brooms and grasses have been planted. (Picture taken about 1895)

The Province Lands, an area of some 3,400 acres, which was purchased from the Indians by the Government and Colony of New Plymouth in 1654, was turned over to the board in 1893 and is still cared for. Many acres have been planted with pine trees.

In 1884 (Resolves, chapter 72) the Topographical Survey Commission was appointed to co-operate with the Federal government in making a topographical survey of the Commonwealth, with the location

of the town boundaries. The commission completed its work and was abolished in 1901 (chapter 409) and its duties were transferred to this board. The results of this triangulation and town boundary surveys have been published in atlasses which are on file in all the cities and towns. The topographical sheets were corrected in part and republished by the State in 1917.

The sale of the Back Bay lands was completed in 1885. The entire area originally amounted to nearly four million square feet. About two million feet went into streets, about four hundred thousand

FIG. 3. — PINE GROWTH ON PROVINCE LANDS

Many thousands of Austrian and Norway pines have been planted successfully in areas where the sand has been held by grass or brush. The soil is nowhere of any depth, but the sand holds the moisture within a few inches of the surface, even on the hills, so that the growth has been successful from the start. Few, if any, areas have been replanted. (Picture taken in 1921)

feet were given away to institutions, and the remainder, nearly one-half of the total, was sold at a profit of nearly three and one-half million dollars, not counting the value of the land given away.

The board devoted much time to the improvement of the small harbors of the Commonwealth and to the protection of the shores from damages by the sea. Its members served on numerous special commissions for investigations and made many reports.

In 1911 (chapter 748) all authority over Boston Harbor was taken away from this board and was given, with considerably increased power, to the Directors of the Port of Boston, a board of five commissioners. The board was reorganized in 1914 to a board of three commissioners.

This board had the duty of developing the Port of Boston. It started the construction of the dry dock and completed the construction of the Fish Pier and the Commonwealth Pier.

The Harbor and Land Commissioners and the Directors of the Port of Boston were abolished in 1916 (chapter 288) and their powers continued in a new board of three, known as the Commission on Waterways and Public Lands.

This commission completed the dry dock and the development of the Commonwealth flats, and negotiated the sale of the land for the Army Base and the sale of the dry dock to the Federal government. It was active in harbor improvements during the war.

Division of Waterways and Public Lands

In 1919, on the reorganization and the consolidation of the various State boards and commissions, the Commission on Waterways and Public Lands was co-joined with the Massachusetts Highway Commission, each forming a division of the Department of Public Works. There are two associate commissioners with each division and the commissioner of the department serves as chairman of each and is the administrative head of the department. The functions of the division remain unchanged.

The sale of the South Boston flats has not been completed. There are still considerable areas available for industrial use, with large areas reserved for wharves and railroad connections. Its value to this city has been very great and will continue to increase.

It was reported in 1879 that the area was approximately seven hundred and fifty acres, partly filled, representing a net cost to the State of about seven hundred thousand dollars. While no accurate balance sheet for the development of this area has been made up, it is interesting to note that the assessed value of this area today, land and buildings, is in excess of one hundred million dollars.

From this brief outline of its history it easily can be surmised that the division has inherited a great variety of duties. Though its functions are more or less completely defined in chapter 91 of the General Laws, there are numerous other provisions of law that affect it.

So far as its usual relation with the public is concerned the work of the division may be divided into two classes:

First, its construction work for the improvement of rivers and harbors and the protection of the shores with sea walls, jetties and riprap. In this work, outside of Boston, the State has spent about five and three-

quarter million dollars, of which approximately three-quarters of a million have been contributed by other parties at interest. At the same time the Federal government has spent over nine million dollars. In Boston Harbor and port improvements the State has expended over twenty-two million dollars and the Federal government about fourteen million dollars. These figures are gross expenditures, and are presented to indicate the magnitude of the work that the State has undertaken. There are, of course, receipts from the sales of land, rentals and operations that reduce the figures for Boston Harbor considerably.

Second, the division has another relation with the public in its oversight of all construction work in or over tidewaters, great ponds and the Merrimack and Connecticut rivers, where no such work can be done under the law without a license. In licensing structures the division fixes the charge for the tidewater displacement, and recommends to the Governor and Council the proper charge for the use and occupancy of any flats beyond the line of riparian ownership.

There have been many special commissions appointed and reports made on subjects connected with the work of this division and its predecessors that have not been mentioned in this brief statement. For this has been an attempt to trace back the history of the present board, and to indicate how its work was started and has finally developed in a continuous record for over one hundred and forty-five years.

CHLORINATION OF WATER AND SEWAGE

By Earle B. Phelps*

(Presented before the Sanitary Section, B. S. C. E., on February 3, 1926)

It is estimated that not less than 30,000,000 people in the United States, living in some 3,000 communities, are today supplied with a chlorinated domestic water. When we consider that this situation has been developed within sixteen years, and that it has involved the addition to public water supplies of a chemical substance previously known chiefly as a bleaching agent and a deodorant, it is apparent that chlorination must possess certain unique characteristics as a water treatment process. This is found to be the case. In the simplicity and low cost of the necessary mechanical equipment, the ease and possible rapidity of installation, and the results obtainable per unit of operating expense, chlorination stands alone.

Presumably there is no need of discussing before this audience either the historical development of chlorination or its major purpose. It may be worth our while, however, to look over this vast experiment in sanitation and to discuss briefly some of the more important results. In particular, it will be of interest to inquire into the principle of disinfection and its chemical basis, the legitimate and proper rôle of chlorination in water supply practice, and the accomplishments and possibly some of the shortcomings of the process itself.

Germicidal Action of Chlorine

The first large scale application of calcium hypochlorite to a public water supply in this country was made at Jersey City in 1908. The application of any chemical substance to drinking water was at that time likely to lead to public disapproval, and, apparently in an attempt to offset this and to disguise the true nature of the treatment, the solution of hypochlorite employed was referred to as "potential oxygen." The use of this term was defended upon the theory that chlorine acted solely as an oxidizing agent. This theory had been established in con-

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nection with the bleaching properties of chlorine, and it was apparently applied to disinfection without any further supporting data. It was not accepted at that time by the present writer, and later investigations have convinced those who have given the matter serious study, that the oxidation theory is not tenable. Unfortunately, it has gained a somewhat permanent foothold in the literature and is apparently quite widely held.

The chemical arguments against this theory have been most ably summarized by *Race*. Briefly they show that in comparison with other oxidizing agents, the relative germicidal power of chlorine is much greater than its relative oxidizing power. Even more striking evidence is readily at hand in the case of the disinfection of a highly polluted water or sewage. Here a selective action is plainly manifest which enables one to distinguish the two independent reactions due to the oxidizing and to the germicidal properties of chlorine itself. In the treatment of sewage, for example, it is quite possible to bring about a 90 per cent destruction of bacteria with a simultaneous oxidation of organic matter in general of less than 10 per cent.

Other lines of evidence leading to the same conclusion might be recited, but enough has been shown to support the view now fairly established that the germicidal action of chlorine is a specific toxic action similar in its general effects to the action of phenol, copper sulphate and other non-oxidizing germicides.

It may be well at this point, also, to suggest that chlorine is in no sense a suitable reagent for oxidation of organic matter in general. Conceivably it could be used in sufficient concentration to accomplish the work of an oxidizing sewage filter, but the quantity required would be entirely out of the question, and the by-products of the reaction might be even more offensive than the original substances. References in the very early literature to the use of bleaching powder, and of permanganate and other oxidizing agents in the treatment of polluted streams, are likely to be misleading upon this point, but in each case the slight benefit derived was merely due to a delayed putrefaction in the stream, resulting from the germicidal effect of the chemical.

Rôle of Chlorination in Water Supply Practice

In the litigation which followed the introduction of the hypochlorite treatment at Jersey City, the merits of the new process were frankly and fully weighed against those of recognized procedures in dealing with polluted streams. The arguments for and against the new process were

ably presented and the case for chlorination won the decision. It was felt by many of us at the time that there was grave danger that this new process might be too readily accepted as a substitute for more thorough measures of water and sewage treatment. Its very cheapness and simplicity threatened to bring about a condition of unsound practice which might discredit the process itself, and for a time the friends of chlorination were busily engaged in warning against this possibility. *Mr. George A. Johnson*, speaking before this Society in 1909, felt obliged to say, under the heading "A Note of Caution," "It is not a panacea for all water ills. . . ." For once in the history of sanitation there was actual danger that a sanitary achievement of real merit might be too readily adopted.

Sixteen years later we are in a much better position to discuss this matter in the light of theory and experience. During that time the old hypochlorite process has been almost completely superseded by liquid chlorine, and the process of chlorination has become a well-nigh universal one in water works practice. It has not only been quite generally adopted in the case of those slightly polluted waters where some simple and cheap means of protection is sought, but it has also been used as an adjunct to filtration processes of all sorts. This development has permitted the use of higher loading factors upon filters, measured both in terms of initial pollution and of rates of filtration, and has also, in many cases, provided a wider margin of safety between a badly polluted water and the consumer.

At the present time there is considerable discussion of the propriety of the use of chlorination alone in the treatment of moderately polluted water supplies. A distinction is made between filtered and unfiltered supplies. Such a distinction, however convenient, has apparently led to a confusion of the real issue, and it is believed that this matter can be dealt with more satisfactorily upon the basis of certain general principles and without reference to filtration as a possible supplementary process.

In studies of rainfall, run-off of streams and pollution of streams as measured by bacterial content, it is found quite generally that the fluctuating numerical values tend to group themselves about a modal value according to the ordinary law of the distribution of errors. In the cases mentioned, however, this distribution is geometric rather than arithmetic, *i.e.*, values of twice the mode are about as frequent as values of half the mode. In a more precise way it may be stated that all these various kinds of data when plotted on Hazen's logarithmic probability paper tend to give a straight-line relation. It has been shown that this law, applied to the case of stream flow, not only accounts for the usual

fluctuations, but shows the probability of occurrences of extreme droughts and great floods.

It is quite natural, therefore, that the output of a water treatment plant should show daily and even hourly fluctuations of the same nature. A typical example of this is shown in Fig. 1 plotted from data by West and Siddon. In view of this condition it is quite permissible to believe that those more serious failures in plant operation which occur from time

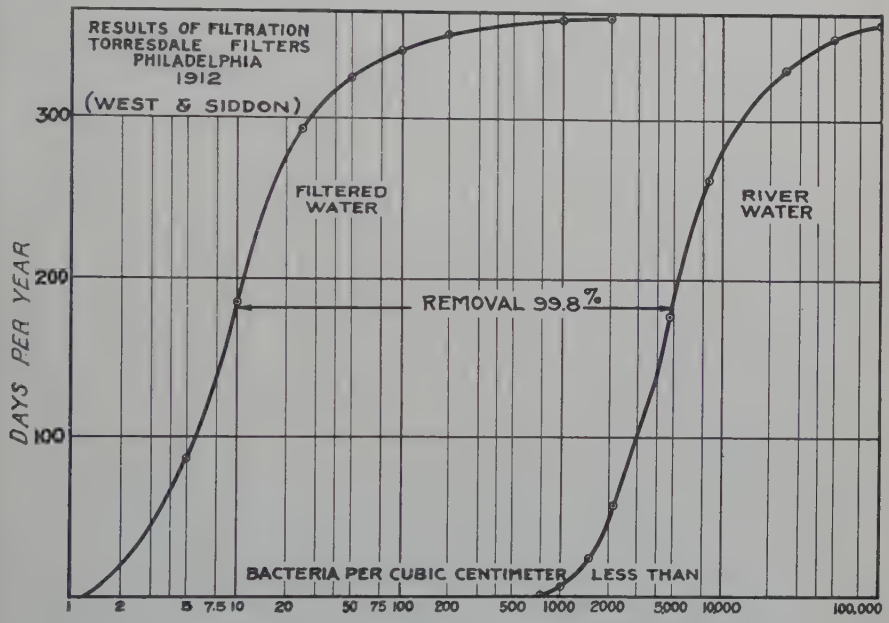

FIG. 1. — THE FREQUENCY DISTRIBUTION OF BACTERIAL NUMBERS IN A POLLUTED RIVER WATER AND IN A FILTERED WATER. Data from West & Siddon

(From Phelps' "Principles of Public Health Engineering," courtesy of The Macmillan Company)

to time, and even a possible breakdown of the plant itself, are in no sense accidental, but are in fact to be anticipated in the same way in which great floods are anticipated in the studies previously referred to.

However we may regard this matter, we cannot avoid the fact of variability in the product, nor the possibility, even though remote, of occasional partial or complete failure. It is well, therefore, to superimpose upon the usual treatment by filtration with its accompanying auxiliary processes, an independent process of high efficiency which will

tend to smooth out the curve of performance, normally satisfactory, and in time of need function as a major process. For this purpose chlorination is ideal, as it provides a wide margin of safety at a small cost. The test of this type of usage is that the discontinuance of chlorination would only occasionally or possibly affect the public health.

In most cases of chlorination following filtration, however, somewhat greater reliance is placed upon the former. Filters are operated under such pollution loads and rates that the output is consistently unsatisfactory until chlorinated. Thus chlorination becomes a part of the major process and the margin of safety is narrowed. The test of this condition is that the discontinuance of chlorination would result in immediate and certain, not merely occasional or possible, effect upon the health of the consumer.

Just as no sharp line of demarcation can be drawn between these two criteria, immediate and certain on the one hand, and occasional or possible on the other, so it must ever remain a matter of judgment just how far the "margin-of-safety" purpose of chlorination may safely be encroached upon in order to economize in capital and operating expenditures. The point is developed at this time merely to draw attention to its true significance. It is not the fact of filtered or unfiltered waters that determines the limits of chlorination, but rather the quality of the water with which the chlorination must deal.

In the chlorination of raw waters or waters not otherwise treated, exactly the same conditions prevail. A water supply of the quality of that of New York City, where sparsely inhabited watersheds and great storage reservoirs provide a large measure of protection against serious contamination, and yet where bacteriological evidence points to an ever-present pollution of minor character, chlorination constitutes an ideal protective measure. From such a typical case we may proceed by imperceptible stages to such waters as those of the Ohio River, where filtration is unquestionably required. The cities of the Great Lakes seem to occupy a position which is just about on the border line. Cleveland, Detroit, and others have adopted filtration only in recent years, while Chicago relies wholly upon chlorination, but is seriously considering more effective measures. Milwaukee also has made a beginning in this direction, while Buffalo and many of the smaller cities still rely upon chlorination. It is clear, therefore, that in the case of unfiltered waters as well as in the case of filtered waters there is a zone within which chlorination is being relied upon more and more as a major process of treatment, and another zone in which chlorination may be regarded

largely as a factor of safety and only occasionally as a major treatment, and that the line of demarcation between these two zones is not clean cut but is almost wholly a matter of professional judgment.

Reliability of Chlorination

In order to establish a basis for judgment, it will be desirable to inquire into the general reliability of chlorination processes as measured by the possibility and effects of mechanical failure; the reliability of control methods for regulating the dosage; the germicidal efficiency as affected by variable water conditions; and other matters of similar concern.

Equipment. — Mechanically the chlorinating apparatus has been developed to a high stage of efficiency. The service to which these machines is put, however, is one of extreme severity, and no time out is permitted for repairs. The practice, therefore, of providing duplicate equipment is fortunately becoming common, for it is most desirable. Certainly in situations in which a great responsibility rests upon the chlorination, ample provision should be made for stand-by equipment. In the larger plants, with multiple units, this matter is readily taken care of, but more attention should be given to it in the smaller, single-unit plants.

During the construction of the powder works at Nitro, West Virginia, in 1917, an outbreak of intestinal disorder seriously impaired the work. Investigation showed that the chlorine plant had been out of order for a day or more owing to the breaking of a gauge glass.

Another possibility of mechanical failure lies in the practice of installing the wrong type of equipment for the service required. At Charleston, West Virginia, in 1917, there was a rather serious outbreak of typhoid fever which *Dr. A. W. Freeman* traced to the water supply. In this case the water was filtered and chlorinated. The filters, however, were overloaded and poorly maintained. The chlorinator was of the manual control type, although the pumping rate was variable. Apparently a fire had thrown a heavy demand upon the pumping plant, and the chlorinator either was incapable of meeting this demand, or was not reset to do so.

These two instances from the writer's personal experience are cited as illustrations of possible mechanical shortcomings. As a rule, the equipment companies deal directly with water boards, and the duty plainly devolves upon them to sell and install only such equipment as is

adapted to the conditions and can be relied upon to function at all times. This comment is offered the more freely because it is known to represent the present policy of the responsible equipment companies themselves, — a policy in which they are entitled to the support of our profession.

The matter is dealt with at this length because in no other kind of treatment is it possible to imagine any sort of oversight or temporary neglect which could do such immediate and serious damage as the temporary shut-down of a chlorinator, used as a major treatment. This danger is well recognized by the New York City authorities, even though the water in question is but slightly polluted. Their policy, as recently stated by *Mr. W. W. Brush*, is to treat the water at many points, so that failure at any one point would not be serious. This policy is worthy of more general adoption.

In brief, there is no reason, from a mechanical equipment and operation point of view, why chlorination should not be put upon a thoroughly reliable basis. To do this, however, it must be recognized, as *Brush* points out, that dependence upon chlorination for safety demands "a higher degree of insurance of adequate and absolutely continuous treatment of the water than has been the general practice to date."

Control. — Much progress has been made in recent years in the matter of control with reference to suitable dosage. In the early days of the hypochlorite treatment, dosage was regulated by trial, with the help of bacterial tests. This system possessed but little flexibility and was responsible for much overdosing and consequent bad taste. It was also probably responsible for much underdosing.

In a plant installed by the writer at Laconia, New Hampshire, in 1910, a system of control was developed in which the newly discovered "o-tolidine" test was used to assure a proper rate of dosage. A preliminary experimental comparison with the results of bacterial tests furnished the basis for the standardization of the chemical test, which was thereafter employed in routine control. Since that time the "o-tolidine" test has been made quantitative and is used as a standardized procedure. In view, however, of the great diversity of waters and their impurities, it is not believed that this test can be standardized any more than the dosage itself. In each type and condition of water there is a certain relation between chlorine dosage, bacterial efficiency, and the residual chlorine after a given lapse of time. Until we have much more information upon the general process this relation cannot be formulated in general terms, but must be determined for each water by comparison with the bacterial findings. *Harold* and *Ward*, for example, found that no reliance at all could be placed upon the "o-tolidine" test, as recom-

mended, in the case of a water carrying a considerable amount of colloidal organic matter.

On the other hand, when the test is properly standardized for a given water, it becomes a valuable and almost indispensable guide to proper dosage. At Wilmington, Delaware, for example, hourly tests are made and the dosage regulated accordingly, with most excellent results. At Cincinnati, according to *Bahlman*, three years' operation at a fixed rate of 0.15 p.p.m. resulted in annual average B. coli values of from 0.4 to 0.7 per 100 cc. Subsequently the dosage was varied in accordance with residual chlorine tests. This resulted during eighteen months in an average dosage of 0.23 p.p.m. and an average B. coli value of 0.14 per 100 cc., with zero values during four months.

A detail of dosing to which too little attention has been given in the past is the distribution of the chlorine in the water. Hydro-diffusion in dilute solution is a slow process, and mechanical mixing is more important in the case of chlorine than in the case of water softening, or other chemical reagents. This is due to the fact that, unlike these other chemicals, chlorine is rather quickly reduced by chemical reaction, and the rate of such reduction increases with its concentration.

The practical aspects of this matter have been pointed out by *Brush*, and also by *Graf* at St. Louis, who reported, "The bacterial reductions caused by chlorine were far from satisfactory until a baffle was built in the chamber to aid in mixing the chlorine with the water."

Significance of Aftergrowths. — In the bacterial control of the process it has frequently been noted that there is an apparent "aftergrowth," as a result of which examinations made at remote points in the system show higher B. coli values than those made at the plant. This point is commented upon by *Race*, but without satisfactory explanation. It is well illustrated in the data from Cincinnati given by *Bahlman*. Accepting the view that it represents a true aftergrowth, we may agree with *Race* that it possesses no sanitary significance. Unfortunately it is almost as difficult to conceive of B. coli multiplying in the mains as it is to think of the typhoid organism similarly multiplying.

An experience at Cumberland, Maryland, may throw some light upon this matter. The water was chlorinated before filtration. Samples taken after chlorination indicated excellent results but the filtered water always contained B. coli in considerable numbers. The explanation finally worked out was simple but unexpected. The accumulated organic matter on the filter quickly exhausted the chlorine in the water before it had accomplished its work and the water was imperfectly disinfected. Samples collected before filtration, however, remained in the bottles for

some time before examination and the chlorine had ample time to complete the disinfection.

In many water mains there is a surface coating of organic growth which is probably capable of reducing chlorine compounds fairly rapidly. It is just possible that the situation thus created is like that existing in the case of Cumberland, and that the so-called "aftergrowth" in fact represents a too rapid exhaustion of the chlorine from the water, and imperfect disinfection. *Graf* has recorded an experience at St. Louis which tends to bear out this view. He says: "The reduction in bacteria in the water flowing through the steel line is always less than in the water in the brick conduit. Charges of chlorine great enough to give tests for free chlorine in the water in the brick conduit three hours after treatment give no test in the steel line three minutes after." In any event, aftergrowths should be looked upon with suspicion until their status in each case has been more fully determined.

What Chlorination has Accomplished

It should be self-evident that all such tests as the residual chlorine tests and the B. coli index are at best presumptive. The expert realizes this to be the case, but the emphasis sometimes placed upon these matters might readily suggest to the layman that these results are the purpose of the treatment.

The true test of water purification, as of water quality in general, is the effect upon the consumer. We have classic examples of great reductions in typhoid fever death rates following water filtration, notably at Pittsburgh and at Philadelphia. It ought not to be difficult to find similar examples of the results of chlorination. Undoubtedly there are good and sufficient examples, but, unfortunately for this case, many of the examples commonly cited will not bear close analysis. There are several reasons why it is very difficult to measure the effect of chlorination.

In the first place, it was begun gradually, often surreptitiously, and in most early cases imperfectly. Hence we have no clean-cut point of departure. Again it was introduced at a time when typhoid fever was rapidly disappearing. Examples of the statistical errors introduced by this fact will be cited. Finally, the pasteurization of city milk supplies, which probably shares with improved water supplies a large part of the credit for typhoid reductions, came into general use at about the same time. The data require a much more refined treatment than has usually been given them, in order to bring out the real facts.

In dealing with this subject we may safely pass over, without serious comment, a type of treatment in which the decreasing typhoid

death rate in the United States is plotted in comparison with the increasing use of chlorinated water, or filtered water or whatever else it may happen to be that the author is interested in. Beautiful reciprocal curves are obtained by this method and would be obtained just as well by plotting typhoid deaths against the number of telephone installations. An even more serious misuse of data is to compare typhoid rates of twenty years ago with those of today, and ascribe the difference to any particular cause. Such gross treatment of statistical data cannot fail to lead to error.

A much more serious effort has been made by various authors to study the actual data of certain cities before and after chlorination. It would seem that such a procedure would yield definite information. Unfortunately an attempt has usually been made to extend the two comparison periods, especially the early one, too far and thus mask any real significance which the data may possess.

Thus from various earlier papers and from his own experience, *Race* has compiled data covering twelve cities. He compares average typhoid death rates over a period of from three to ten years before chlorination with similar rates two to five years following chlorination, showing the result in terms of per cent reduction. The essential data are shown in Table I. Similar data may, of course, be computed over the same periods for any community in which no important change has been made in the water supply. This has been done for Boston, and the results are shown in the last column for comparison with *Race*. In seven out of the twelve cases the percentage reduction was less in the city which had improved its water supply than in Boston over the same period.

TABLE I. — REDUCTION IN TYPHOID FEVER DEATH RATES AT VARIOUS PLACES FOLLOWING THE ADOPTION OF CHLORINATION (FROM RACE), AND REDUCTIONS AT BOSTON DURING THE SAME PERIODS.

City.	Periods Compared	Reduction in Typhoid Rate (Per Cent)	Reduction in Typhoid Rate at Boston during Same Periods (Per Cent)
Baltimore	1900–10; 1912–15	36	60
Cleveland	1900–10; 1912–16	77	64
Des Moines	1905–10; 1911–13	41	49
Erie	1906–10; 1912–14	70	46
Evanston	1908–11; 1912–13	50	43
Jersey City	1900–08; 1909–16	55	57
Kansas City, Missouri	1900–10; 1911–16	66	62
Omaha	1900–09; 1911–16	53	64
Trenton	1907–11; 1911–14	35	37
Montreal	1906–10; 1911–16	37	53
Toronto	1906–10; 1912–16	75	55
Ottawa	1906–10; 1913–17	50	61

It is evident that some more refined treatment of the data is required to bring out the essential facts. This may be accomplished in several ways.

Race shows a very complete case in the city of Ottawa, Canada, with a control in the city of Hull using the same water. He also shows as control data the death rates in Ottawa from other causes than water-borne diseases. During 1914 a water-borne outbreak occurred in Hull

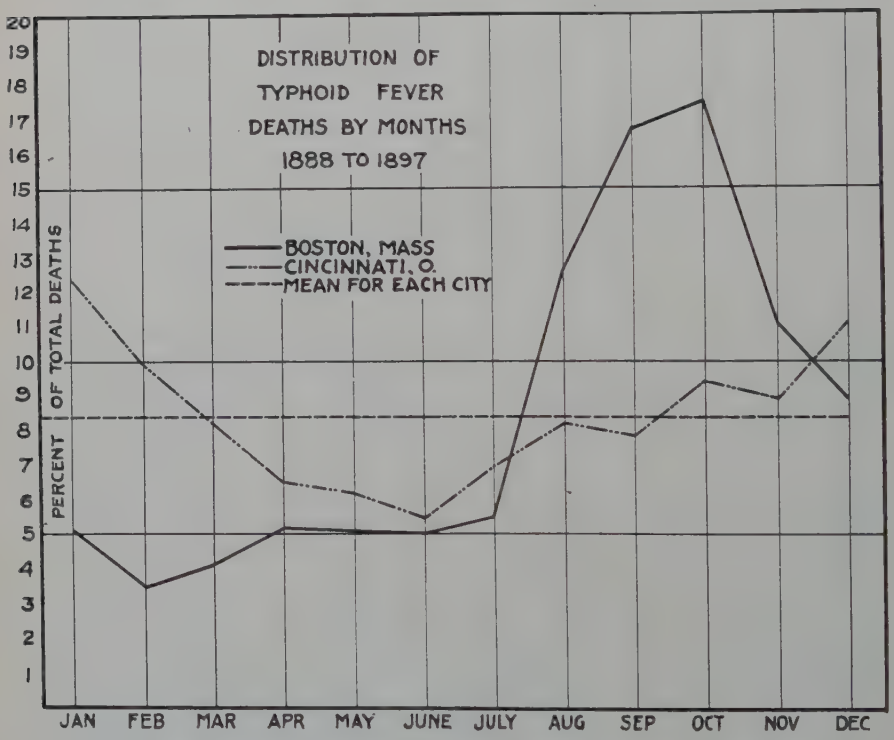

FIG. 2. — THE SEASONAL DISTRIBUTION OF TYPHOID FEVER AS RELATED TO THE QUALITY OF WATER SUPPLY. Data from Sedgwick & Winslow

(From Phelps' "Principles of Public Health Engineering," courtesy of The Macmillan Company)

giving a case rate of 1,000 per 100,000 population, the rate at Ottawa remaining normal.

Another type of illustration of the benefits of chlorination appears in the statistics of both Milwaukee and Cleveland. In Cleveland, according to *Collins* and *Perkins*, the typhoid rate in 1913 was noticeably affected by changes in the rate of dosage. At Milwaukee it is said in the

"Journal of the American Medical Association," by a writer who is usually well informed, that some experiments were made in 1916 to reduce the taste of the chlorine in the water by use of a neutralizing chemical. The typhoid rate for that year showed a marked increase.

Another method of study which may yield results is by means of the seasonal distribution of typhoid fever. *Sedgwick* and *Winslow* have shown that typhoid is normally a hot weather disease, with a maximum incidence in the late summer or fall. But they also noted that a city with

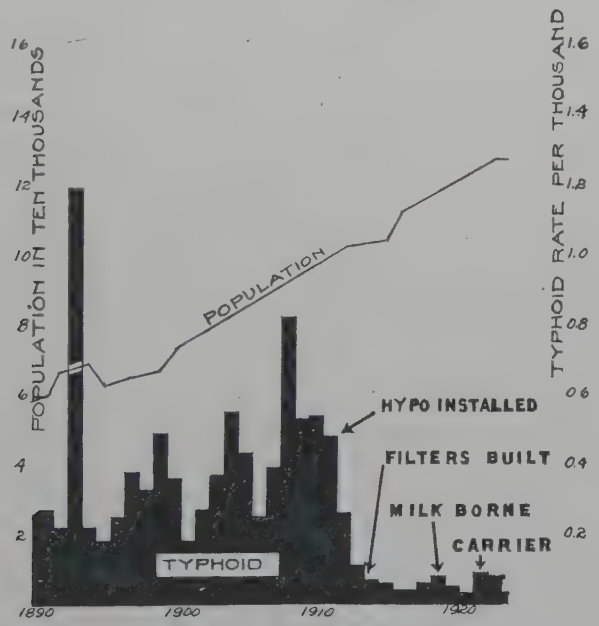

FIG. 3. — THE TYPHOID FEVER RATE OF TRENTON, N. J., BEFORE AND AFTER CHLORINATION

(Courtesy of New Jersey State Department of Health)

a polluted water supply frequently showed a winter or early spring rise often mounting to a maximum for the year. The facts are well illustrated in Fig. 2, drawn from *Sedgwick* and *Winslow's* data. The curve for Boston shows a characteristic fall peak, while that for Cincinnati shows the influence of polluted water.

Employing this statistical method, *Jackson* shows by diagram, not only a drop in the annual typhoid fever death rate in Cleveland following chlorination, but a decided shift in the monthly distribution of deaths.

A similar shift in the distribution of typhoid fever took place at Kansas City, Missouri, following chlorination of the water supply, as shown by *High*.

In a case like that of Trenton, New Jersey, where a badly polluted water was treated by an efficient and well-operated system of chlorination from the start, a simple chart gives a more satisfactory picture than statistical averages. Thus the somewhat dubious showing of the Trenton data, as employed in Table I, is immediately cleared up by such a chart as has recently appeared in "Public Health News" (New Jersey State Department of Health) and reprinted here by permission. (Fig. 3.) However, statistical treatment is necessary if we are to attempt to evaluate the results of any sanitary measure. To this end, and in view of the failure of other procedures, the author is studying this general problem by comparison of trends before and after the event, rather than by averages. A single illustration of the method will be offered. For reasons which will not be gone into at this time, typhoid death rates are believed to show geometric trends; that is, their logarithms plotted against the time tend to follow straight lines as long as there is no change in the general sanitation. Any change is reflected, not in the average rate before and after, but in the direction of the trend.

For example, Milwaukee installed efficient chlorination in 1913. For the five years previous the average typhoid death rate (geometrical mean) was 25 and for the five following years 8.6, — a reduction in rate of 65 per cent. In Boston for the same periods the reduction computed in the same way was from 12 to 5.7, or 53 per cent. The difference is not striking. The trend at Milwaukee before chlorination, was upward at a rate of 1.07, each yearly rate being, on the logarithmic trend line, 1.07 times the rate of the preceding year. After chlorination the trend was 0.93, a total change of 14 per cent annually. In Boston, on the other hand, when only the normal improvements in sanitation were being made, the trends for the same periods were 0.76 and 0.74, respectively, — a change of 2 per cent.

It is not to be inferred from what has been said that the actual results of chlorination have in general been overestimated, except perhaps by a few enthusiasts, or that there is any question in the mind of the writer as to the important part chlorination has played in the general reduction of the typhoid fever death rate. The picture of the Trenton situation is sufficiently convincing, but the treatment accorded the same data in Table I conceals the true effect and substitutes a false one. The results at Cleveland, Milwaukee, and elsewhere show the disaster that may follow the temporary failure of chlorination, and thus measure to

some extent its value as a preventive measure. If, by the general method of comparison of typhoid rates before and after chlorination, certain reductions are improperly credited to chlorination, this is probably more than offset in those cities which have continued to use waters of increasing pollution loads which, without the help of chlorine, would have suffered seriously. This phase of the matter can never be evaluated statistically, nor can it ever be estimated how many epidemics have been prevented among those communities that employ chlorination as an insurance feature in the absence of any evidence of pollution in the water and without any past history of water-borne typhoid.

Tastes and Odors

Just at present the question of tastes and odors in chlorinated drinking waters is receiving considerable attention. The subject has always been an important one, but it has been aggravated in recent years by the increasing pollution of water supplies by certain industrial wastes. Phenol, in particular, which occurs in the waters of many industrial processes such as the manufacture of coal gas, coke, and various dyestuffs, if present in traces too small to detect by taste and almost beyond reach of chemical analysis, will, when chlorinated, give rise to a "medicated" or iodoform taste in the water which is highly objectionable. Milwaukee has had a most unfortunate experience in this connection, described by *Cunliffe*, and Cincinnati is experiencing continual trouble supposedly from the coke plants upriver. There seems to be no other remedy than to keep the offending wastes out of the river.

Of a similar nature, but less serious, are the various tastes and odors resulting from the chlorination of a water supply rich in organic matter. Chlorine substitution compounds are formed which generally possess powerful odors. A curious treatment for some of these troubles, as described by *Bushnell*, is a slightly higher rate of dosage. *Enslow* has made similar observations. Attempts have been made, particularly in England, to overdose still more heavily and then to neutralize with a dose of some antiachlor, such as thiosulphate or permanganate.

This question of tastes constitutes one of the chief objections to chlorination. In reasonably pure waters it is not often troublesome. The difficulties become greater with increasing pollution.

Bathing Places

The chlorination of water for use in swimming pools has been practiced for some years and in many places. As a result of the investigations of a joint committee of the American Public Health Association

(Sanitary Engineering Section), and of the Annual Conference of State Sanitary Engineers, the sanitation of bathing places has been rather well standardized as to principles and practice.

Regarding disinfection, this and other work has shown the futility of merely providing a circulating system by which a portion of the water is continuously filtered and disinfected. The requirements are that the pool itself shall contain a germicidal solution in order that freshly added infectious material may be immediately acted upon. Some chemical treatment, therefore, capable of maintaining a permanent effect in the water is essential. Chlorination is well adapted to this purpose. A constant residual chlorine in the pool, amounting to from 0.3 to 0.5 p.p.m., is recommended. This is strong enough to be effective and yet under proper supervision will not cause smarting of the eyes or other undesirable results.

In the protection of beaches and other outdoor bathing places we have to do with methods of sewage treatment rather than those of water treatment, and some reference will be made to this subject later. One rather unique situation, however, has been developed at Washington, District of Columbia, which is described by *Baker* and *McNab*. Here a large lake, the "tidal basin," is fed by the Potomac River during rising tides. It has become a popular bathing place. To protect against a considerable degree of pollution in the river, the waters used for bathing are treated in place from a boat upon which the necessary chlorine tanks and mechanical equipment are mounted. This boat traverses the area adjacent to the bathing beach at regular times and has proved quite effective.

Chlorination of Sewage

Although the chlorination of sewage was, in this country, at least, the forerunner of water chlorination, it has not thus far become a matter of such general interest. It is, however, worthy of some attention at this time because of certain unique advantages which it possesses in the general field of sewage treatment, and, again, because it illustrates quite clearly certain chemical and biological principles of the general process which are always obscure and often not apparent in the case of water chlorination.

Sewage treatment has three distinct objectives, often combined in one process but capable of clear differentiation. These refer to the three types of nuisances resulting from stream pollution, namely, putrefaction of organic matter, resulting in odors, loss of oxygen and destruction of fish and other life; deposit of solids in slack water or upon shores and

river banks; and dangerous bacterial pollution of water supplies, shellfish areas, and bathing places. The first of these has its remedy in oxidizing treatments, the so-called filters, and the newer aeration processes; the second, in tank treatments or screening; the third in some form of disinfection.

Many of the usual types of sewage treatment result in incidental improvement in the bacterial content of sewage. In particular, the oldest — intermittent slow sand filtration — and the most recent — the activated sludge process — may each be operated as disinfecting processes of rather high efficiency. In general, however, bacterial removal is but incidental to the primary purpose of these oxidation processes. For efficiency and economy in producing a reasonably disinfected effluent, either by itself or in conjunction with other objectives, chlorination possesses great merit. This is particularly the case when the other purposes of sewage treatment are not involved.

In the investigations made by the author for the International Joint Commission, for example, it was found that the Great Lakes and their connecting rivers possess ample powers of self-purification to care for the sewage of the cities along their shores, except for the bacterial pollution of the waters used below for domestic supplies. The recommendations laid down called for remedial treatment in which chlorination is to be the major feature. The sewage treatment program at Detroit has been based upon this finding. At Providence, chlorination of the partially treated sewage is provided to protect important oyster-growing areas, and at Cleveland the largest chlorination plant in the world is operated primarily to protect the bathing beaches. (Fig. 4.)

It seems reasonable to expect that chlorination will be more frequently employed in the future as its merits become better understood and as the need for better protection of our inland and coastal waters becomes more manifest. Such a development will be facilitated by a fuller recognition of certain chemical and biological principles, outlined by the author in his original paper. The two more important principles will be briefly discussed at this time.

A principle of chemical disinfection, which holds also in thermal disinfection — pasteurization of milk, for example — is that the process is a time-intensity product, or, more specifically in chemical disinfection, a time-concentration product. The bacteria destroyed by chlorine in sewage may be the same kinds as those destroyed in water, but in the one case we use concentrations of 10 p.p.m. or thereabouts, and in the other from 1 to 0.1 p.p.m., depending upon the water. This is not because it takes more chlorine to destroy more bacteria, but because the chlorine

itself is destroyed or rendered non-available by organic matter. If we plot the concentration of available chlorine in a chlorinated sewage against the time of reaction, we obtain a rapidly falling curve of logarithmic type, dropping from, say, 10 parts at the beginning to zero in ten or twelve minutes. In a domestic water a similar curve is obtained dropping from 0.5, say, to 0.01 over a period of perhaps ten hours.

FIG. 4. — ONE OF THE SEWAGE CHLORINATING PLANTS AT CLEVELAND, OHIO

(Courtesy of Wallace & Tiernan Company)

It would be unsafe to suggest that the areas under these two curves must be equal for equal results, — in percentage, — for the relation is somewhat less simple than this, but there is some such definite relation. Some power or other simple function of the concentration, if plotted in this way, would undoubtedly yield an area strictly proportional to the total germicidal effect. A proper appreciation of this principle would lead to a better understanding of the "residual chlorine" test and its

significance in water treatment. In particular it would indicate the importance of the time factor, which is often disregarded in current discussion of the water treatment process. In sewage treatment this time relation is of great economic importance, since it calls for a balancing between the cost of storage and the cost of chemicals in such a way that local conditions may frequently determine the economic rate of chlorine application.

Another general principle of chlorination, best illustrated in sewage practice, is the specific action of chlorine as a toxic agent in distinction from its action as an oxidizing agent. Reference has already been made to the selective action of chlorine for bacteria as compared with organic matter in general. It has been shown that the two simultaneous but independent reactions, the germicidal and the oxidizing, have different concentration exponents, and this and other facts may be utilized to suppress the wasteful oxidizing reaction and obtain the maximum benefit from the germicidal reaction. In water works the cost of the chlorine is a negligible amount in comparison with the total cost of water delivered to the consumer, and economy is not a factor to be considered. In sewage disinfection the cost may run into a good many dollars per million gallons, this cost being largely for chlorine. Any possible economy, therefore, is well worth while.

Conclusion

In brief summary and conclusion, the chlorination of public water supplies has already completely altered our conception of pure water, profoundly modified our engineering practice, conserved the public funds, and improved the public health. The disinfection of sewage has yet to assume its true rôle in our program of sanitation, but it possesses possibilities of equally useful development, — possibilities which it has not yet become necessary or advantageous fully to explore. These two major developments together with their by-products, the disinfection of swimming pools, of oysters, and of milk bottles, the deodorization of industrial waste gases, various therapeutic uses and other uses of minor importance, certainly entitle the general subject of chlorination to a chapter of its own in the history of sanitation.

A list of references follows:

References

American Public Health Association (Sanitary Engineering Section).
"Reports of Committee on Sanitation of Bathing Places." American Journal of Public Health, Vol. **12**, 1922, p. 121; Vol. **14**, 1924, p. 597.

Bahlman, Clarence.
"The Cincinnati Water Supply and the New U. S. P. H. S. Standard." Journal, American Water Works Association, Vol. **14**, 1925, p. 260.

Baker, W. P., and McNab, P. E.
Canadian Engineer, Vol. **47**, 1924, p. 507.

Brush, W. W.
"Secondary Chlorination of New York Water Supply." Journal, American Water Works Association, Vol. **14**, 1925, p. 526.

Bushnell, W. B.
"Over-Chlorination for Taste Control." Journal, American Water Works Association, Vol. **13**, 1925, p. 653.

Collins, R. J., and Perkins, R. G.
"Typhoid in Cleveland in 1903." Cleveland Medical Journal, Vol. **13**, 1915, p. 757.

Cunliffe, Russell W.
"Chlorophenol Tasts in Milwaukee's Water Supply." Journal, American Water Works Association, Vol. **14**, 1925, p. 423.

Enslow, Linn H.
Discussion of paper by Buswell and Boruff. Journal, American Water Works Association, Vol. **14**, 1925, p. 384.

Freeman, Dr. Allen W.
"Typhoid Fever Epidemic at Charleston, West Virginia." Public Health Reports, Vol. **32**, 1917, p. 1308.

Graf, A. V.
"The Chemical Treatment of the St. Louis Water Supply." Journal, American Water Works Association, Vol. **5**, 1918, p. 279.

Harold, Maj. C. H. H., and Ward, Capt. A. R.
Journal, Royal Army Medical Corps, Vol. **42**, 1924, p. 414; Vol. **43**, 1924, p. 14.

High, S. Y.
"Hypochlorite Sterilization at Kansas City, Missouri." Proceedings, American Water Works Association, 1912, p. 225.

International Joint Commission.
"Report of the Consulting Sanitary Engineer upon Pollution of Boundary Waters and Remedial Measures." Washington and Ottawa, 1916.

Jackson, D. D.
"Chlorination at Cleveland, Ohio." Proceedings, American Water Works Association, 1912, p. 219.

Johnson, George A.
"Sterilization of Public Water Supplies." Journal, Association of Engineering Societies, Vol. **46**, 1910, p. 12.

Phelps, Earle B.
"The Disinfection of Sewage and Sewage Filter Effluents." U. S. Geological Survey, Water Supply Paper 229, Washington, 1909.
"Principles of Public Health Engineering," New York, 1925.

PUBLIC HEALTH NEWS.
New Jersey State Board of Health, January, February, 1926.
RACE, JOSEPH.
"Chlorination of Water," N. Y., 1918.
SEDGWICK, W. T., AND WINSLOW, C.-E. A.
"Statistical Studies of the Seasonal Prevalence of Typhoid Fever." Memoirs, American Academy of Arts and Sciences, Vol. **12**, 1902, No. 5.
WEST, F. D., AND SIDDON, J. S. V.
Journal, New England Water Works Association, Vol. **27**, 1913.

Of General Interest

ANNUAL MEETING AND SMOKER

Presentation of Prizes and President's Address provide Interesting Program at Annual Meeting — Buffet Supper, Radio Broadcast and Illustrated Talk on "Tracing the Frontier of Alaska" are Features of Smoker.

Once again the third Wednesday of March, this year the Seventy-Eighth Annual Meeting of the Boston Society of Civil Engineers, and St. Patrick's Day landed on the same day. The flamboyant program, showing even the snow on Mt. St. Elias a sickly green, did not keep away the crowd, for over two hundred attended.

After taking up the annual reports of the officers and committees, seldom an exciting event, the Society turned to the interesting feature of awarding the various prizes for the year. Desmond FitzGerald made the presentation of the Desmond FitzGerald Medal to Frank C. Shepherd. Charles W. Sherman presented copies of Clemens Herschel's "Frontinus and the Water Supply of Ancient Rome" to Edward P. Hamilton and to Dr. Charles Terzaghi. John E. Carty gave the Designers Section award of books to B. A. Rich and W. W. Bigelow, and H. L. Ripley announced the award of the Sanitary Section prize to F. W. Haley.

At the close of the business session the retiring president, Gen. R. K. Hale, gave a most interesting address on "The Development of the Division of Waterways and Public Lands of the Massachusetts Department of Public Works." His paper is published in this number of the JOURNAL. Further details as to the business meeting will be found in this JOURNAL under "Proceedings of the Society" and "Annual Reports."

Following General Hale's address, the meeting adjourned to the other end of the City Club Auditorium where an excellent buffet supper was awaiting the members. London "cabby" hats, with brilliant green hatbands, amply disguised the members of the "oldest engineering society" in the country. Here and there the hats were quite becoming, but for the most part — well, you wouldn't have trusted the wearers with a nickel!

After supper opportunity was given for "milling around" a bit before the program arranged by the Social Activities Committee, under the chairmanship of Hugh D. Chase, commenced. The first feature was a scene in a Radio Broadcasting Studio, which apparently amused the crowd. (The Social Activities Committee hereby apologizes for not being able to "knock" all the members in connection with this stunt — but time did not permit.)

The principal event on the program

was a talk, illustrated with slides and movies, by Asa C. Baldwin, on "Tracing the Frontier of Alaska from the Arctic Ocean to Mt. St. Elias." Mr. Baldwin pictured in a most interesting manner his experiences in Alaska on the International Boundary Survey. His talk included not only an account of the hazardous work in connection with this survey (much of it above the timber line), but also scenes from Alaska giving a much different picture of that little-known part of our continent than most of us previously had.

Judging by the few "cabby" hats left in the auditorium when the smoker broke up, we prophesy that these headpieces will be worn on gala occasions by the "young fry" in many greater Boston households.

Program Suggestions Wanted

The Program Committee welcomes suggestions from members of the Society as to topics which they would like to have presented during the coming year. It is difficult to determine what subjects are the most desirable, and the advice and suggestions of individual members are most helpful. If there is some particular project which might provide an interesting opportunity for the June excursion or outing, why not send the Program Committee (or the Secretary) a memo about it?

Industrial Fuel and Power

An outstanding feature of the activities of The Affiliated Technical Societies of Boston for the current year was its two-day session on Fuel and Power, held on December 10 and 11, 1925.

"Industrial Fuel and Power" has now been printed in order that the papers presented at this meeting might be available in permanent form. This publication of 106 pages, containing the ten papers on Industrial Fuel and Power, together with the discussions, furnishes a valuable addition to the literature on the subject.

The many aspects covered in this publication are shown by the following list of titles and authors of papers:

"Coal — The Basic Fuel," *F. H. Daniels.*
"Supply and Utilization of Fuel Oil," *E. H. Peabody.*
"Diesel Engines for New England Power Plants," *J. F. Hecking.*
"Possibilities of Obtaining Industrial Power from Public Service Corporations," *L. R. Nash.*
"Power for Textile Mills," *Charles T. Main.*
"Power for the Paper Industry," *Joseph A. Warren.*
"The Utilization of Power in the Typical New England Plant," *K. D. Hamilton.*
"Advantages and Disadvantages of High Steam Pressure in Industrial Plants," *Joseph Pope.*
"Utilization of Extraction Steam," *E. D. Dickinson, A. D. Somes* and *R. G. Standerwick.*
"The Supply of Industrial Power," *W. H. Larkin, Jr.*
Round Table Discussion on Industrial Power.

Copies of "Industrial Fuel and Power" may be obtained at $1 each, at the headquarters of The Affiliated Technical Societies of Boston, 715 Tremont Temple, Boston (Tel. Congress 5462).

Boston & Maine Railroad Builds Coke Reclamation Plant

A plant for reclaiming coke from locomotive ashes is being constructed by the Boston & Maine Railroad at East Somerville, adjacent to its roundhouse and shops. It is expected that the railroad will be able to obtain in this manner

practically all the fuel required for station heating. Present station requirements aggregate approximately 30,000 tons a year.

This project, so far as known the first of its kind by any railroad in this country, will recover from the locomotive waste now dumped into ash heaps unburned coke which tests have shown to average from 33 to 40 per cent of the ash. The Boston & Maine expects to recover approximately 30 per cent by the new process.

This process is an adaptation of one used in the hard coal fields for separating impurities. It is based on the comparative specific gravity, and by means of water flotation the coke is segregated and the cinder residue precipitated.

The new plant will cover an area approximately 30 x 100 feet. It will cost about $50,000, and will handle 2,000 tons of ashes weekly, from which approximately 600 tons of coke are expected to be reclaimed. It has been found that a considerable quantity of combustible coke is taken from fire boxes in the cleaning of locomotives after each trip, and this unburned material is expected to make up a large part of the new product.

The cinders to be handled by the new plant will be largely those dumped from locomotives in Greater Boston roundhouses and shops, but if the results warrant, the reclamation process may be extended to apply to the ashes from locomotives elsewhere on the system.

The foundations for this plant have been installed by the New England Foundation Company, and the superstructure is being erected by John H. Proctor & Co.

PROCEEDINGS OF THE SOCIETY

MINUTES OF MEETINGS

Boston Society of Civil Engineers

MARCH 17, 1926. — The seventy-eighth annual meeting of the Boston Society of Civil Engineers was held today at the Boston City Club, and was called to order by the President, Richard K. Hale, at 5.10 P.M.

The reading of the minutes of the previous meeting (February 17, 1926) was omitted, as they were published in the March JOURNAL.

The Secretary reported for the Board of Government the names of those elected to membership:

Member: Warner C. Brockway. *Juniors:* James F. Berry, Earle S. Cochrane, Hampar B. Hamparian, Ransom W. Stiles.

The President announced the death of George T. Sampson, on February 25, 1926, who had been a member of the Society for forty-eight years, and stated that a committee would be appointed to prepare a memoir.

It was announced that the Board of Government had VOTED to omit the April meeting of the Society on account of the Affiliation meeting to be held on April 21, 1926, on "Latest Developments in Concrete."

The annual reports were then taken up. The reports of the Board of Government, Treasurer, Secretary, Committee on Library, Committee on Social Activities, and the Committee on Subsoils of Boston were presented.

It was VOTED that these reports be accepted and placed on file. The President announced that these would be published in the April JOURNAL.

It was VOTED that the incoming Board of Government be authorized to appoint such committees as it deemed advisable.

Mr. Guy C. Emerson presented the report of the Tellers of Election, and in accordance therewith the President announced that the following officers had been elected:

President — Charles M. Allen.
Vice-President (for two years) — Frank E. Winsor.
Secretary — John B. Babcock, 3d.
Treasurer — Frank O. Whitney.
Directors (for two years) — Raymond W. Coburn, Harry E. Sawtell.
Members of the Nominating Committee (for two years) — Edgar S. Dorr, Arthur L. Shaw and Sturgis H. Thorndike.

General Hale then presented Prof. Charles M. Allen, the newly elected President, who spoke briefly.

At the request of the President, Mr. Desmond FitzGerald presented the Desmond FitzGerald Medal to Frank C. Shepherd for his paper on "The Preservative Treatment of Ties on the Boston & Maine Railroad" published in the March, 1925, JOURNAL.

The President announced that the Board of Government had awarded copies of Clemens Herschel's "Frontinus and the Water Supply of Rome" to Edward P. Hamilton for his paper on "The Development of the Science of Hydraulics," published in the October, 1925, JOURNAL; and to Dr. Charles Terzaghi for his paper on "Modern Conceptions Concerning Foundation Engineering," published in the December, 1925, JOURNAL. Mr. C. W. Sherman made the presentations to Mr. Hamilton and Dr. Terzaghi.

Mr. H. L. Ripley, Chairman of the Sanitary Section Award Committee, announced that the Sanitary Section Award had been made to F. W. Haley for his paper on "Recent Additions to the Sewerage System of and the Disposal Works of Framingham, Mass.," presented before the Sanitary Section on March 4, 1925, and published in the June, 1925, JOURNAL.

Mr. J. E. Carty, Chairman of the Designers Section Award Committee, presented the Section Award of books, suitably inscribed, to B. A. Rich and W. W. Bigelow for their paper on "Stresses in a Composite Member Subjected to Bending and Direct Stress," presented before the Designers Section on January 13, 1926, and published in the February, 1926, JOURNAL.

The retiring President, General Richard K. Hale, then delivered his annual address, "A Brief History of the Development of the Division of Waterways and Public Lands of the Massachusetts Department of Public Works," and the business meeting thereupon adjourned and the members attended the supper and entertainment provided by the Committee on Social Activities. An account of the entertainment will appear in the news items of the April JOURNAL. There were 212 members and guests present.

Adjourned about 9.30 P.M.

J. B. BABCOCK, *Secretary.*

Sanitary Section

MARCH 3, 1926. — The annual meeting of the Sanitary Section was held in the library of the Affiliated Technical Societies of Boston, Wednesday, March 3, 1926. Preceding the meeting, thirty-three members of the Section met at Marston's Dining Room for dinner.

The meeting was called to order by the Chairman at 7.15 P.M. Reading of the minutes of the previous meeting was omitted. The report of the Executive Committee was read and duly accepted. The report of the Committee on the Disposal of Garbage was read and accepted.

The report of the Nominating Committee was presented by Mr. Gordon M. Fair, Chairman of the Committee. The following officers were nominated for the ensuing year:

For Chairman — G. Gale Dixon.
For Vice-Chairman — F. W. Gilcreas.
For Clerk — Ralph W. Horne.
For Members of the Executive Committee: E. Sherman Chase, F. L. Flood, R. G. Tyler.

By vote of the Section, the Chairman of the Nominating Committee was instructed to cast one ballot for the entire slate and the nominees were declared elected.

The Chairman of the Section then introduced the Chairman-elect, Mr. Dixon, who made a few timely remarks.

The regular program announced for this meeting could not be carried out as the films of the Milwaukee Activated Sludge Plant had not been received. The Chairman announced that these films and the accompanying talk would be given on Wednesday, March 10, immediately following the meeting of the Designers Section in Chipman Hall.

Mr. M. C. Whipple of Harvard University was then introduced and spoke upon the "Operation of the Cambridge Water Purification Works," explaining in considerable detail the method of operation of the various parts of the plant and the results accomplished.

Following this talk Prof. R. G. Tyler of Technology was introduced and spoke regarding "Intestinal Diseases as an Index to the Sanitary Quality of Public Water Supply." Professor Tyler's talk was illustrated with several lantern slides. Both talks brought out considerable discussion. Those taking part in the discussion were Messrs. Dixon, Marston, Fales, Doane, Dorr and Fair.

Messrs. H. P. Eddy, Jr., and Edgar S. Dorr were appointed as additional members of the Committee on the Disposal of Garbage.

There were 50 present at the meeting.

Adjourned at 9 P.M.

R. W. HORNE, *Clerk.*

MARCH 10, 1926. — A special meeting of the Sanitary Section was held today in Chipman Hall immediately following the meeting of the Designers Section.

The films of the Milwaukee Activated Sludge Plant which failed to arrive in time for the annual meeting were shown and explained by Mr. Almon L. Fales of Metcalf & Eddy. A vote of thanks was given Mr. T. Chalkley Hatton for his courtesy in loaning the films to the Section.

There were 55 present at the meeting.

Adjourned at 9.00 P.M.

R. W. HORNE, *Clerk.*

Designers Section

MARCH 10, 1926. — The annual meeting of the Designers Section of the Boston Society of Civil Engineers was called to order at 6.10 P.M. in Chipman Hall, Tremont Temple.

The minutes of the January meeting were read and approved.

The chairman of the Nominating Committee then read the report of this committee, giving the following slate of officers for the coming year:

Chairman — Waldo F. Pike.
Vice-Chairman — Henry C. Sheils.
Clerk — Scott Keith.
Executive Committee: D. V. C. Birrell, William D. Henderson, K. C. Reynolds.

It was moved and seconded that nominations be closed. The motion was carried. It was moved and seconded that the Clerk cast one ballot electing the above officers. Motion carried and the Clerk cast the required ballot.

The retiring chairman, J. Stuart Crandall, then introduced Prof. George F. Swain who in turn introduced the speaker of the evening, Mr. Robins Fleming of the American Bridge Company, who spoke on "The Theory and Practice of Wind Bracing in Industrial and Multi-story Buildings." A general discussion followed the paper.

There were 120 members and visitors present.

The meeting was adjourned at 7.45 P.M.

SCOTT KEITH, *Clerk.*

Highway Section

FEBRUARY 24, 1926. — The annual meeting of the Highway Section of the Boston Society of Civil Engineers was held in the Affiliation Rooms in Tremont Temple Wednesday evening, February 24, with an attendance of about 40 members and guests.

Mr. R. W. Coburn, Vice-Chairman, presided in the absence of the Chairman, Mr. Henry A. Varney.

The annual report of the Executive Committee was read and accepted.

The Vice-Chairman appointed a nominating committee consisting of Mr. A. B. Appleton, Mr. J. B. Babcock and Mr. A. P. Rice.

The nominating committee retired, returning later with the following nominations:

Chairman — R. W. Coburn.
Vice-Chairman — Samuel Hobbs.
Clerk — H. F. MacWilliams.
Members of Executive Committee: Frank Morris, A. W. Hunt, D. A. Ambrose.

A motion was made and carried that the Clerk cast one ballot for the above-named nominees.

Mr. Coburn then introduced the Hon. Charles R. Howard, Chairman of the Commission of State Administration and Finance, as the speaker of the evening.

Mr. Howard gave an interesting talk on the workings of the Finance Committee, briefly outlining the future policy of the Commission, and at the conclusion answered a number of questions asked him by the members.

The meeting adjourned at 10.15 P.M.

H. F. MacWilliams, *Clerk.*

APPLICATIONS FOR MEMBERSHIP

[April 15, 1926]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

For Admission

Addison, Alexander Scott, Cliftondale, Mass. (Age 40, b. Edinburgh, Scotland.) Attended public schools in Edinburgh. Came to America in 1903. Employed by General Electric Company, Lynn, from August, 1903, to August 1906; August, 1906, to June, 1916, with S. Morgan Smith Company as draftsman, then sales engineering; from June, 1916, to the present time sales engineer with The James Leffel Company, Springfield, Ohio, specializing in smaller hydraulic equipment. Refers to C. M. Allen, R. A. Hale, W. F. Uhl, D. M. Wood.

Carson, Wallace Stirling, Quincy, Mass. (Age 29, b. Quincy, Mass.) Started as rodman in 1913 for E. W. Branch, civil engineer, in Quincy, then became transitman; in 1917 with N. Y., N. H. & H. R.R. as computer on bridges; in 1918 in charge of Quincy tracts for U. S. Housing Corp. — part of the year in the army; 1919–25 with E. W. Branch, during which period he had charge of laying out of 20,000-ton dry dock and wharfs adjacent at Fore River Plant also in charge of pole survey for Quincy Electric Light and Power Company. Since 1925 has been City Engineer of Quincy. Refers to Perry Lawton, W. S. McKenzie, G. H. Newcomb, E. C. Sargent.

Chapin, Robert Curtis, Cambridge, Mass. (Age 21, b. Boston, Mass.) Student at Northeastern University, and employed part time by the city of Newton. Refers to H. B. Alvord, I. W. Hastings, J. W. Ingalls, W. P. Morse, W. E. Nightingale, A. Q. Robinson.

Goldberg, Israel, Boston, Mass. (Age 21, b. Slavata, Russia.) Graduate of Mass. Inst. Tech., 1925, in civil engineering. From June to August, 1925, suburban surveying; the balance of the summer and until February, 1926, estimating for a roofing concern; since February, 1926, with the Boston & Maine R.R. as structural draftsman. Refers to J. B. Babcock, H. L. Bowman, C. B. Breed, Pusey Jones, C. M. Spofford, Hale Sutherland.

McNamara, Stephen James, Medford, Mass. (Age 27, b. Manchester, England.) Keyham Naval College, England, in 1915; Lowell Institute three years to date.

Heating and ventilating estimator from January, 1921, to August, 1922; from August, 1922, to March, 1923, draftsman, with Appleton Company, Lowell; from April, 1923, to August, 1923, reinforced concrete draftsman with Monks & Johnson; from September, 1923 to December, 1923, reinforced concrete draftsman with Aberthaw Company; from May to July, 1924, draftsman with Stone & Webster; from August, 1924, to August, 1925, designer with Jenks & Ballou, Providence, R. I.; and from September, 1925, to date with Stone & Webster, Inc., as designer. Refers to S. K. Cohen, L. S. Cowles, H. P. Fessenden, J. J. Harty, C. E. Nichols.

Rae, Arthur Nicholson, Jamaica Plain, Mass. (Age 19, b. Boston, Mass.) Student at Northeastern University and during the co-operative periods is with Schein & Levine, architects and engineers. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

Robinson, Porter O., Jamaica Plain, Mass. (Age 49, b. Lawrence, Mass.) Graduate of Lawrence Scientific School, Harvard, 1898; seven years with New England Telephone and Telegraph Company; seven years with Edison Electric Illuminating Company; three years in the World War; in business for himself for about six years, specializing in perfecting, waterproofing and wearproofing concrete surfaces as well as heavy membrane waterproofing. Refers to A. L. Gammage, W. E. McKay, L. E. Moore, J. F. Osborn, A. L. Shaw.

Thompson, Edward Henry, Norwood, Mass. (Age 30, b. Norwood, Mass.) Northeastern University, 1914–1917. During work periods while in college he was employed as rodman and transitman by Aspinwall & Lincoln; 1919, transitman, Aspinwall & Lincoln; 1920, United Fruit Company as topographical draftsman; 1920 to 1926, transitman in charge of field party of N. Y., N. H. & H. R.R., real estate and right of way department, where he is at present. Refers to C. G. Barry, E. H. Lincoln, A. L. Maddox, J. R. McLeish, G. A. Smith.

Turner, Leon B., Somerville, Mass. (Age 24, b. White River Junction, Vt.) Educated in Manchester High School, Franklin Union one year, and at present in his second year at Lowell Institute. From May, 1920, to September, 1922, employed by Gay & Doust, civil engineers, at Manchester, N. H.; from April to December, 1923, employed by Fay, Spofford & Thorndike on survey work on the Queen City bridge at Manchester, N. H.; from December, 1923, to date with Fay, Spofford & Thorndike as draftsman. Refers to C. A. Farwell, Erwin Harsch, R. W. Horne, W. F. Pike, B. A. Rich, S. H. Thorndike.

Waters, Louis Henry, Boston, Mass. (Age 40, b. Minneapolis, Minn.) Educated in University of New Mexico, 1921–23; Western School of Estimating and Plan Reading, Denver, Colo.; 1923–25, student in architectural design and engineering, Mass. Inst. Tech.; November, 1907–May, 1908, rodman, chainman and assistant instrumentman; June, 1908, to May, 1910, ranching and construction, twenty-five miles irrigation canal for French Land and Irrigation Company; May, 1910–June, 1913, yard foreman and engineer corps, Kansas City Stock Yard Company; February to June, 1914, fire guard and assistant forest ranger, U. S. Forest Service; June, 1914–April, 1915, steel erector; April, 1915–February, 1916, instrumentman; July, 1916–October, 1917, forest ranger; April, 1919–January, 1920, recreational survey; October, 1917–March, 1919, topographical and observation service, U. S. Army; July, 1920, to July, 1921, carpenter and carpenter's foreman; July to September, 1922, inspector and assistant building superintendent; July, 1925, to date, building draftsman and designer, Morton C. Tuttle Company. Refers to O. B. Brown, T. J. Conroy, H. A. Gray, Erwin Harsch.

For Transfer from Junior

Dearborn, Elmore L., Brookline, Mass. (Age 27, b. Hampton, N. H.) Graduated from Northeastern University, June, 1922, with degree of B.C.E. During college worked for Aspinwall & Lincoln in 1920–21 as rodman and transitman; in 1923 he was transitman for two months for the town of Milton and one month with Whitman & Howard; in July, 1922, he entered the street en-

gineering division of the Edison Electric Illuminating Company and is still with them. Refers to H. B. Alvord, F. L. Flood, E. L. Johnson, O. F. Mann, W. E. Nightingale. (*Elected a Junior, November 16, 1921.*)

FURRIER, JOSEPH P., Lynn, Mass. (Age 26, b. Lynn, Mass.) Graduated from Northeastern University in 1923 with degree B.C.E. During his four years in college he worked with Eastman & Bradford as rodman and transitman on survey work; with Aspinwall & Lincoln, as transitman; and with Mass. Dept. of Public Works, Division of Highways. Since graduation has been in the City Engineer's office, Medford, as chief of party until May, 1924; from May, 1924, to date with the Mass. Dept. of Public Works, Division of Highways, as assistant on two concrete roads and three macadam roads, and is now in charge of a survey party for the Department. Refers to H. B. Alvord, A. B. Appleton, A. O. Bradshaw, A. E. Kleinert, Jr., F. H. Morris, J. H. O'Connor. (*Elected a Junior, November 16, 1921.*)

MILNE, DAVID C., Boston, Mass. (Age 27, b. Topeka, Kan.) Graduate of Northeastern University. Since 1921 he has been employed by Whidden Beekman Company on building construction, and at present is field engineer for them. During 1919 and 1920 on survey work with this firm and J. L. Woodfall. Refers to H. B. Alvord, F. L. Flood, J. W. Ingalls, W. E. Nightingale. (*Elected a Junior, November 16, 1921.*)

NEW MEMBERS

Members

WARNER C. BROCKWAY, 66 Lake Avenue, Melrose, Mass.

MORTIMER M. GIBBONS, 61 Warren Avenue, Mattapan, Mass.

JOHN F. HENNESSY, 29 Hawthorne Road, Brookline, Mass.

THEODORE B. PARKER, Wellesley Farms, Mass.

Juniors

ALPHONSE A. CHERNESKY, East 15, Tufts College, Mass.

EARLE S. COCHRANE, 188 Larch Road, Cambridge, Mass.

LELAND C. FITTS, 95 Mountfort Street, Boston, Mass.

CHRISTOS HARMANTAS, 177 Franklin Street, Cambridge, Mass.

Annual Reports

Report of the Board of Government for the Year 1925–26

Boston, March 17, 1926.

To the Boston Society of Civil Engineers:

Pursuant to the requirements of the By-Laws, the Board of Government presents its report for the year ending March 17, 1926.

Membership

Seventy-eight members in all grades have been added during the year, of whom 11 were former members reinstated. Fourteen juniors have been transferred to the grade of member.

During the year 21 members have resigned, 41 have forfeited membership for non-payment of dues, and 10 have died, making the total deductions 72.

The present membership of the Society consists of 7 honorary members, 792 members, 134 juniors, 21 associates, and 4 members of the Sanitary Section only, making a total membership of 958, a net gain for the year of 6.

Deaths

The loss by death during the year has been 10, as follows:

Frank T. Westcott, October 12, 1924.
George M. Clukas, June 28, 1925.
Willard M. Foster, July 5, 1925.
Charles W. Eaton, July 21, 1925.
Gunnar E. Loefquist, July 21, 1925.
Clarence A. Perkins, September 12, 1925.
George H. Towle, September 21, 1925.
Ralph D. Hood, January 9, 1926.
Leonard Metcalf, January 29, 1926.
George T. Sampson, February 25, 1926.

Remission of Dues

Under authority of By-Law 8, the Board of Government has remitted the dues of 5 members.

Exemption from Dues

Forty-three members have been exempt from dues in accordance with the amendment to By-Law 8, which provides that "a member of any grade who has paid dues for forty years, or who has reached the age of seventy years and has paid dues for thirty years, shall be exempt from further dues."

Regular Meetings

Seven regular meetings have been held during the year, and an inspection trip to the construction work under way for the new Providence Water Supply. This trip, made jointly with the New England Water Works Association on June 25, 1925, took

the place of the regular meeting in June. The regular meeting in May was omitted on account of the meeting of the Affiliated Technical Societies of Boston on May 14, 1925, at which Dr. Alexanderson, Chief Engineer of the Radio Corporation of America, spoke on "Modern Developments in Radio." The December meeting was omitted on account of the two-day session on Fuel and Power held by the Affiliated Technical Societies of Boston on December 10 and 11, 1925.

The average attendance at the meetings of the Society was 170, the largest being about 300 and the smallest 95. The practice of serving buffet suppers before the meetings has been continued, and, from all appearances, this feature meets with the hearty endorsement of the members.

At these meetings papers and addresses have been given, or special discussions held, as follows:

March 25, 1925. — Annual meeting. Address of the retiring President, Edwin H. Rogers, "Some Random Notes on Transportation;" followed by smoker and entertainment.

April 15, 1925. — "Problems of the Construction Industry," by Brig.-Gen. R. C. Marshall, Jr., General Manager of the Associated General Contractors of America, followed by discussion.

September 30, 1925. — "Some Problems of Highway Operation," by G. H. Delano, Maintenance Engineer, Massachusetts Department of Public Works, Division of Highways; followed by discussion.

October 21, 1925. — "The Report of the Engineering Board of Review of the Sanitary District of Chicago on the Lake Lowering Controversy." John R. Freeman presented the subject of lake levels, navigation and water power; and Harrison P. Eddy discussed the question of sewage disposal and related matters. Mr. Freeman also spoke on the subject of a "National Hydraulic Laboratory," telling of the progress abroad.

November 18, 1925. — "Modern Conceptions Concerning Foundation Engineering," by Dr. Charles Terzaghi, Head of Department of Civil Engineering, Robert College, Constantinople, and Special Lecturer on Foundation Engineering, Massachusetts Institute of Technology; followed by discussion.

January 27, 1926. — Joint meeting with the Sanitary Section, B. S. C. E. "The Engineer and Public Health," by Dr. George E. Vincent, President of the Rockefeller Foundation. This address was broadcast by Station WSSH, Tremont Temple, Boston.

February 17, 1926. — Joint meeting with the M. I. T. Student Chapter, American Society of Civil Engineers; Harvard Engineering Society; Tufts Civil Engineering Society; and the Northeastern University Section, B. S. C. E. "The Bartlett's Ferry Hydroelectric Development," by H. A. Hageman and T. B. Parker, presented by Mr. Hageman; followed by discussion.

Sanitary Section Meetings

The Sanitary Section has held 6 meetings during the year, with an average attendance, including the joint meeting with the Society, of 57. The following papers have been presented:

March 4, 1925. — Annual meeting. "The Sewerage Works of Framingham, Massachusetts," by F. W. Haley, Assistant Engineer, with Barbour & Dixon.

October 7, 1925. — "Some Observations upon Sewage Treatment in England and Germany," by Almon L. Fales of Metcalf & Eddy.

December 2, 1925. — "Hydrogen-ion Control in Chemical Treatment of Tannery Wastes," by Stuart E. Coburn, Chemist, with Metcalf & Eddy; and "A Plant for the Degreasing of Wool Scouring Wastes," by George G. Bogren, Sanitary Engineer, with Weston & Sampson.

January 6, 1926. — "The Sanitary Conservation and Utilization of Water Resources," by W. L. Stevenson, Chief Engineer, Pennsylvania Department of Health, and Secretary of the Pennsylvania Sanitary Water Board.

January 27, 1926. — Joint meeting with the Society. "The Engineer and Public Health," by Dr. George E. Vincent, President of the Rockefeller Foundation.
February 3, 1926. — "Chlorination of Water and Sewage," by Prof. Earle B. Phelps of the College of Physicians and Surgeons, Columbia University.

Designers Section Meetings

The Designers Section has held 7 meetings during the year, with an average attendance of 47. The following papers have been presented:

March 11, 1925. — Annual meeting. "Reconstruction of Harvard Bridge," by Lewis E. Moore, Consulting Engineer.
April 8, 1925. — "The New Water Supply of the City of Providence, R. I.," by Frank E. Winsor, Chief Engineer of the Water Supply Board of the City of Providence.
May 13, 1925. — "The Engineer Takes Wings," by Charles M. Emerson, New England Manager of the Fairchild Aerial Surveys, Inc.
October 14, 1925. — "Theory *versus* Practice in Concrete Construction," by R. K. Hallock of the Aberthaw Company.
November 11, 1925. — "The Wells River and Woodsville Bridge," by C. R. Perry and Kendall Woodrough of J. R. Worcester & Co.
December 9, 1925. — "Fundamentals of Mass Form and Proportion," by C. Howard Walker of Walker-Walker and Kingsbury.
January 12, 1926. — "Stresses in a Composite Member Subjected to Bending and Direct Stress," by B. A. Rich and W. W. Bigelow of Rich, Bigelow & Tirrell. "The Effect of 'Cal' on Cement and Concrete," by M. N. Clair of the Thompson & Lichtner Company.

Highway Section Meetings

The Highway Section has held 2 meetings and an inspection trip during the year, as follows:

February 25, 1925. — Annual meeting.
September 17, 1925. — Inspection trip to the Canton-Stoughton project, — a dual type of pavement under construction by the Massachusetts Department of Public Works, Division of Highways.
December 5, 1925. — "The Development of Highway Bus Transportation in Massachusetts," by Day Baker of the Motor Coach Association.

Northeastern University Section Meetings

The Northeastern University Section has held 2 meetings during the year, as follows:

May 1, 1925. — Annual meeting. "River and Harbor Improvements in Massachusetts," by General R. K. Hale, Associate Commissioner, Massachusetts Department of Public Works, Division of Waterways and Public Lands.
September 30, 1925. — Special meeting to elect a Chairman of the Section.

Permanent Fund

The Society again authorized the use of the Permanent Fund in payment of current expenses. Details concerning the fund will be found in the Treasurer's report.

Journal

The report of the Editor of the JOURNAL for the calendar year 1925 shows that there have been printed ten issues, containing a total of 626 pages, the number of copies of each issue printed being 1,250. The net cost of the JOURNAL in 1925 was $2,485.90

or $3.97 per page. The net cost in 1924 was $2,531.84, or $3.37 per page. The increased cost per page in 1925 was due principally to a change in column width and number of lines per page.

Commencing with the January, 1925, number several changes were made in the JOURNAL. These modifications consisted in the addition of a section "Of General Interest," to include short articles or items of current value, an improved cover design and table of contents, and various changes in type, size and arrangement. That these changes have met with the approval of the readers is clearly shown by the favorable comments which have been received.

A special committee of 25 members has recently been appointed to co-operate with the Committee on Publication in getting material for the section "Of General Interest." It is certain that the special committee will be a great help in securing the proper material for the JOURNAL.

Desmond FitzGerald Medal

In accordance with the report of the Committee appointed to recommend the award of the Desmond FitzGerald Medal for the best paper, by a member of the Society, published during the year, the Board has awarded the medal to Frank C. Shepherd for his paper on "The Preservative Treatment of Ties on the Boston & Maine Railroad," published in the March, 1925, JOURNAL.

Section Awards

The Board voted on April 12, 1924, "to present a prize for a worthy paper given in each Section by a member of that Section," this award to consist of books suitably inscribed. The Board has adopted the recommendations of the special committees on Section awards, and has voted that these prizes be awarded this year as follows:

Sanitary Section. — To F. William Haley for his paper on "Recent Additions to the Sewerage System and Disposal Works of Framingham, Massachusetts," presented before the Sanitary Section on March 4, 1925, and published in the June, 1925, JOURNAL.

Designers Section. — To Barzillai A. Rich and William Walter Bigelow for their paper on "Stresses in a Composite Member Subjected to Bending and Direct Stress," presented before the Designers Section on January 13, 1926, and published in the February, 1926, JOURNAL.

Clemens Herschel Award

Clemens Herschel, past President and Honorary Member of the Society, has continued his gift of copies of his book on "Frontinus and the Water Supply of the City of Rome," with the request that the Board award one or more of these books each year as prizes for papers which have been particularly useful and commendable, and worthy of grateful acknowledgment.

The Board has voted to present at this time a copy of this book to Edward P. Hamilton for his paper on "The Development of the Science of Hydraulics," published in the October, 1925, JOURNAL; and to Dr. Charles Terzaghi for his paper on "Modern Conceptions Concerning Foundation Engineering," published in the December, 1925, JOURNAL.

Freeman Fund

At the annual meeting of the Society on March 25, 1925, announcement was made of the establishment of the "Freeman Fund" through the splendid gift by John R. Freeman, past President and Honorary Member of the Society, of securities having a present value of approximately $25,000, and yielding an annual income of $1,700.

No appropriations have been made from this fund during the current year. The President of the Society, after consultation with Mr. Freeman, has appointed the following committee for the administration of this fund:

John R. Freeman, *Chairman*

Charles M. Allen	Hector J. Hughes
Charles T. Main	Robert Spurr Weston

Tinkham Memorial Fund

The "Samuel E. Tinkham Fund" established at the Massachusetts Institute of Technology, by the Society, "to assist some worthy student of high standing to continue his studies in civil engineering," had a value of $2,377.33 on June 30, 1925. The annual income from this fund, available for scholarship aid, is about $125. Mr. John Albert Herlihy, a student in civil engineering of the class of 1927 at Technology, has been awarded this scholarship for both the years of 1924–25 and 1925–26. Under the former method of designating scholarships at Technology it was not possible to announce the name of the recipient for the current year at the annual meeting, but under revised arrangements the name can now be announced at the annual meeting.

The Board desires to call the attention of the members of the Society to the fact that the annual income from the Tinkham Fund is about $125, whereas the tuition at the Massachusetts Institute of Technology is $300 per year. Additional donations to this fund would make it of greater service for the purpose for which it was established, thus enabling a worthy student to receive a greater measure of assistance in continuing his studies.

Sections

The continued activity of the Sections, as indicated in the foregoing part of this report, shows clearly their value to the Society. Your Board believes that these Sections have contributed much to the Society in maintaining an interested membership, in providing excellent material for publication in the JOURNAL, and in affording the members an opportunity for informal discussion of subjects in which they are particularly interested.

Social Activities

The serving of buffet suppers before the meetings has met with the continued approval of the members. Each year the percentage of those attending the meetings, who have also attended the buffet supper, has increased. The Committee on Social Activities deserves great credit for the work they have done in carrying out these affairs so successfully.

Library

The work of revising and rearranging the library has continued; the details are shown in the report of the Library Committee.

Relations with Other Societies

The Society has continued its practice of holding a joint meeting each year with the student civil engineering societies in this vicinity. These meetings have proved of interest to our members and have been greatly appreciated by the student societies.

During the year the Society has co-operated, wherever possible, with the Affiliated Technical Societies of Boston in the arrangement of its program, in joint action by committees, and in the improvements in the library.

Your Board, in concluding this report, desires to express its appreciation of the excellent work done by officers of the sections during the past year. The members of committees and the individual members of the Society deserve much credit for their interest and co-operation which has made the year just ended a prosperous and successful one.

For the Board of Government,

RICHARD K. HALE, *President.*

Report of the Treasurer

BOSTON, March 1, 1926.

To the Boston Society of Civil Engineers:

Your Treasurer presents the following report for the year ending March 1, 1926.

Detailed data are contained in the appended tabular statements: Table 1 gives the receipts and expenditures for the year; Table 2, Comparative Balance Sheets; Table 3, Investment of the Permanent Fund.

The Current Expenses for the year amount to $10,377.47, being $648.02 decrease from the preceding year.

There has been transferred to the Current Fund all the income of the Permanent Fund for the current year, $2,348.76.

The net expense of the JOURNAL has been $54.68 more than last year. The income from advertisements decreased $358.85, and the sale of JOURNALS has been $34.70 less than last year.

There has been an increase in the Permanent Fund of $580 after transferring the income for the current year of $2,348.76 to the Current Fund.

The Freeman Fund was established early in the year, on receipt of stocks donated by Mr. Freeman having a par value of $25,000 and a market value of $25,310. The income received, amounting to $1,357, is unexpended.

Respectfully submitted,

F. O. WHITNEY, *Treasurer.*

TABLE 1. — RECEIPTS AND EXPENDITURES

CURRENT FUND

Receipts

Balance, March 1, 1925		$372 79
Members' dues		7,176 68
Advertisements (net)		825 25
Sale of JOURNALS		159 30
Sale of waste paper		4 38
Library fines		20 66
Income from Permanent Fund		2,348 76
Interest on deposits		7 49
		$10,915 31

Expenditures

JOURNAL:		
Printing	$3,168 48	
Incidentals	36 50	
Reprints	181 15	
Editor	300 00	
		$3,686 13
Rent, meetings		186 00
Salaries (except editor)		316 51
Printing, stationery, postage, etc., meetings		308 61
Printing, stationery, postage, etc., office		309 01
Incidentals, office		122 37
Reporting, meetings		51 00
Stereopticon, meetings		19 00
Binding (net)		140 40
Insurance		33 19
Periodicals		138 40
Annual meeting and smoker		149 39
Social activities (net)		364 08
Affiliated Technical Societies of Boston		3,875 00
Badges (net)		12 00
Designers Section		90 60
Sanitary Section		131 71
Highway Section		20 05
Northeastern University Section		12 10
Renovation of library		411 92
		10,377 47
Balance, March 1, 1926		$537 84

Permanent Fund

Receipts

Balance, March 1, 1925	$736 00
Entrance fees	580 00
Interest received (net)	1,692 81
	$3,008 81

Expenditures

Co-operative banks (net)	$743 85
Income transferred to Current Fund	2,348 76
	$3,092 61
Deficit, March 1, 1926	$83 80

E. K. Turner Fund

Receipts

Balance, March 1, 1925	$66 95
Interest on bond	50 00
	$116 95

Expenditures

Books purchased	$64 20
Balance, March 1, 1926	$52 75

Special Library Fund

Receipts

Balance, March 1, 1925	$200 00
Subscriptions and appropriation	542 91
	$742 91

Expenditures

Improvement of library	$442 91
Balance, March 1, 1926	$300 00

Freeman Fund

Receipts

Stocks having book value of	$25,310 00
Dividends	1,355 00
Interest on deposit	2 00
	$26,667 00

TABLE 2. — COMPARATIVE BALANCE SHEETS

	March 1, 1923	March 1, 1924	March 1, 1925	March 1, 1926
Assets				
Cash	$1,071 46	$1,736 17	$1,375 74	$2,163 79
Bonds and notes	35,023 00	35,023 00	32,835 00	32,835 00
Stock	2,655 75	2,655 75	3,373 11	28,683 11
Co-operative banks	8,877 50	10,135 40	12,198 40	13,598 20
Library	7,500 00	7,500 00	7,500 00	7,500 00
Furniture	2,405 11	2,405 11	2,405 11	2,405 11
	$57,532 82	$59,455 43	$59,687 36	$87,185 21
Liabilities				
Permanent Fund	$46,537 51	$47,547 51	$48,148 76	$48,728 76
E. K. Turner Fund	1,083 24	1,051 45	1,060 70	1,046 50
Current Funds	6 96	53 66	372 79	537 84
Special Library Fund	–	897 70	200 00	300 00
Freeman Fund	–	–	–	26,667 00
Surplus	9,905 11	9,905 11	9,905 11	9,905 11
	$57,532 82	$59,455 43	$59,687 36	$87,185 21

TABLE 3. — INVESTMENT OF PERMANENT FUND, MARCH 1, 1926

	Par Value	Actual Cost	Value as carried on Books
Bonds			
American Tel. & Tel. Co., Col. Tr. 4%, 1929	$3,000 00	$2,328 75	$2,737 50
Union Elec. Light & Power Co. 5%, 1932	2,000 00	2,050 00	2,050 00
Blackstone Valley Gas & Elec. 5%, 1939	2,000 00	1,995 00	1,995 00
Dayton Gas Co. 5%, 1930	2,000 00	2,000 00	2,000 00
Milford & Uxbridge St. Ry. 7%, 1928	3,000 00	2,942 50	2,942 50
Railway & Light Securities Co. 5%, 1939	3,000 00	3,000 00	3,000 00
Superior Water, Light & Power Co. 4%, 1931	4,000 00	3,347 50	3,347 50
Wheeling Electric Co. 5%, 1941	4,000 00	3,845 00	3,845 00
Economy Light & Power Co. 5%, 1956	1,000 00	990 00	990 00
Tampa Electric Co. 5%, 1933	2,000 00	2,000 00	2,000 00
Galveston, Houston Elec. Ry. Co. 5%, 1954	2,000 00	1,940 00	1,940 00
Northern Texas Elec. Co. 5%, 1940	2,000 00	1,932 50	1,932 50
Chicago & Northwestern Ry. 5%, 1987	1,000 00	1,102 50	1,102 50
Vermont Power & Mfg. Co. 5%, 1928	1,000 00	965 00	965 00
American Tel. & Tel. Co. 5%, 1946	1,000 00	993 75	993 75
	$33,000 00	$31,432 50	$31,841 25
Stock			
29 Shares Am. Tel. & Tel. Co.	2,900 00	3,373 11	3,373 11
Total securities	$35,900 00	$34,805 61	$35,214 36
Co-operative Banks			
25 Shares Merchants Co-operative Bank including interest to March		$4,427 00	
15 Shares Volunteer Co-operative Bank including interest to January		1,184 55	
10 Matured Shares Volunteer Co-operative Bank		2,000 00	
35 Shares Watertown Co-operative Bank including interest to March		5,986 65	
			13,598 20
Total value of invested portion of Permanent Fund			$48,812 56
Cash deficit			83 80
Total value of Permanent Fund			$48,728 76
E. K. Turner Fund			
American Tel. & Tel. Co. 5%, 1946	$1,000 00	$993 75	
Cash on hand	—	52 75	
			1,046 50
Total value of Permanent and E. K. Turner Funds			$49,775 26

	Book Value
Freeman Fund	
10 Shares New England Power Co. 6%	$960 00
40 Shares Niagara Falls Power Co. 7%	1,120 00
10 Shares Duquesne Light Co. 7%	1,060 00
10 Shares Cons. Gas, Electric Light & Power Co. of Baltimore 8%	1,230 00
10 Shares Carolina Power & Light Co. 7%	1,020 00
10 Shares Georgia Ry. & Power Co. 1st Pf. 8%	1,080 00
10 Shares Alabama Power Co. 7%	980 00
10 Shares Electric Power & Light Co. 7%	1,000 00
10 Shares Tennessee Electric Power Co. 7%	950 00
10 Shares West Penn. Power Co. 7%	1,030 00
10 Shares Minn. Power & Light Co. 7%	980 00
10 Shares Miss. River Power Co. 6%	900 00
10 Shares Southwestern Power & Light Co. 7%	980 00
10 Shares Utah Power & Light Co. 7%	990 00
10 Shares Montana Power Co. 7%	1,100 00
10 Shares Puget Sound Power & Light Co. Prior Pf. 7%	1,060 00
10 Shares Pacific Gas & Electric Co. Pf. 6%	950 00
10 Shares Pacific Gas & Electric Co. 8%	1,070 00
10 Shares Great Western Power Co. 7%	990 00
10 Shares Southern Calif. Edison Co. 8%	1,180 00
10 Shares Northwestern Electric Co. 7%	980 00
10 Shares Consumers Power Co. 7%	1,020 00
10 Shares Public Service Electric Power Co. 7%	980 00
10 Shares Montreal Light, Heat & Power Co. 8%	1,700 00
	$25,310 00
Cash on hand	1,357 00
Total value of Freeman Fund	$26,667 00

Report of Auditing Committee for Year 1925–26

March 15, 1926.

We have examined the accounts of the Treasurer of the Boston Society of Civil Engineers and find the books correctly kept and the various expenditures of the past year supported by duly approved receipts.

The Treasurer has also accounted to us for the investments and cash on hand, as submitted by the above report.

Charles R. Main,
George A. Sampson,
Auditing Committee of Directors of the Boston Society of Civil Engineers.

Report of the Secretary

BOSTON, March 17, 1926.

JOHN B. BABCOCK, Secretary, *in account with the* BOSTON SOCIETY OF CIVIL ENGINEERS, *Dr.*

For cash received during the year ending March 17, 1926:

From entrance fees, new members and transfers:			
35 new members and associates at	$10 00	$350 00	
32 juniors at	5 00	160 00	
14 juniors transferred to members at	5 00	70 00	
Total from entrance fees			$580 00
From annual dues for 1925–26, including dues from new members		$6,979 52	
From back dues		112 16	
From dues for 1926–27		85 00	
Total from dues			7,176 68
From advertisements			854 00
From sale of JOURNALS and reprints			159 30
From library fines			20 66
From sale of badges			204 00
From binding JOURNALS			35 85
From sale of waste paper			4 38
From Social Activities Committee (smokers)			319 91
From sale of books			130 99
			$9,485 77

The above amount has been paid to the Treasurer, whose receipts the Secretary holds.

The appended table shows the estimated and actual expenditures for the year.

JOHN B. BABCOCK, *Secretary.*

COMPARISON OF ESTIMATED AND ACTUAL EXPENDITURES, 1925–26

Office:	Estimated Expenditures		Actual Expenditures	
Salaries (except editor)	$400 00		$316 51	
Insurance and treasurer's bond	50 00		33 19	
Stationery, printing and postage	325 00		309 01	
Incidentals	150 00		122 37	
Periodicals and binding (net)	325 00		278 80	
Total		$1,250 00		$1,059 88

Meetings:				
Rent	$200 00		$186 00	
Stereopticon and reporting	100 00		70 00	
Printing and postage	300 00		308 61	
Social activities (net)	400 00		364 08	
Annual meeting, 1925 (net)	150 00		149 39	
Total		$1,150 00		$1,078 08
Journal:				
Editor's salary and expenses	$350 00		$336 50	
Printing and postage	3,400 00		3,168 48	
Reprints	350 00		181 15	
Total		4,100 00		3,686 13
Sections		275 00		254 46
Dues to Affiliated Technical Societies of Boston		3,800 00		3,875 00
		$10,575 00		$9.953 55
Appropriation to Special Library Fund				411 92
Total				$10,365 47

REPORT OF AUDITING COMMITTEE FOR YEAR 1925–26

BOSTON, March 15, 1926.

We have examined the records and accounts of the Secretary of the Boston Society of Civil Engineers and have satisfied ourselves that they are properly kept, and that the money received has been transferred to the Treasurer.

CHARLES R. MAIN,
GEORGE A. SAMPSON,
Auditing Committee of Directors of the Boston Society of Civil Engineers.

Report of the Editor

BOSTON, February 17, 1926.

To the Board of Government, Boston Society of Civil Engineers:

The Editor submits the following report for the calendar year 1925 (Volume XII of the JOURNAL).

There have been published twenty-two papers and discussions, forty-seven items or articles "of general interest" and four memoirs of deceased members.

The ten issues of the JOURNAL contained a total of 626 pages; the number of copies printed was 1,250 of each issue. The net cost was $2,485.90 as compared with $2,531.84 for the preceding year. Table 1 includes a comparison of costs for the JOURNAL from 1921 to 1925, inclusive. In table 2 details of cost for Volume XII of the JOURNAL for the calendar year 1925 are shown.

The figures showing cost per page for the year 1925 are not strictly comparable with those for the other years owing to the fact that the column width and the number of lines per page were increased in 1925, thereby reducing the number of pages, with a consequent increased cost per page. The matter included in 1925 was substantially the same in amount as for 1924, but there were nearly four times as many drawings or photographs published in 1925 as in the preceding year.

Commencing with the January, 1925, number several changes were made in the JOURNAL as the result of a careful study by the preceding Committee on Publication. These modifications, which were approved by the Board of Government before being put into effect, consisted of the addition of a section "Of General Interest," to include short articles or items of current value, a new cover design arranged for display of the titles of the papers, a more readable table of contents, changes in column widths and number of lines per page, and a rearrangement of the matter included under "Proceedings of the Society." That these changes have met with the approval of the readers is clearly shown by the favorable comments which have been received.

The Board of Government has recently authorized the appointment of a special committee of about twenty-five members to co-operate with the Committee on Publications, particularly to assist in securing material for the section "Of General Interest." This committee has been appointed to serve for the calendar year 1926, the personnel being selected to represent the various fields of the civil engineering profession in this vicinity. It is certain that this special committee will be a great help in securing the proper material for the JOURNAL.

Respectfully submitted,

JOHN B. BABCOCK, *Editor.*

TABLE 1. — COMPARISON OF COSTS OF JOURNAL, 1921 TO 1925, INCLUSIVE.

YEAR	Vol.	Number of Pages*	GROSS COST†		NET COST‡		Number of Cuts and Inserts
			Total	Per Page	Total	Per Page	
1921	VIII	674	$5,088 48	$7 55	$3,537 91	$5 25	58
1922	IX	560	4,022 14	7 18	2,960 14	5 29	76
1923	X	684	4,162 45	6 09	3,150 50	4 61	86
1924	XI	752	3,676 09	4 89	2,531 84	3 37	39
1925	XII	626§	3,816 45	6 10§	2,485 90	3 97§	146

* Includes Advertising Section and Annual Index.

† Gross cost includes editing, printing, mailing and reprints.

‡ Net cost equals gross cost less amounts received for advertising, subscriptions and sale of JOURNALS and reprints.

§ Costs per page for 1925 not comparable with those of preceding years due to change in column width and number of lines per page.

TABLE 2. — 1925 JOURNAL, VOLUME XII

MONTH	PAGES		NUMBER		COST					
	Papers and Proceedings	Advertising	Inserts	Cuts	Composition and Printing	Inserts and Cuts	Reprints	Wrapping, Mailing and Postage	Editing*	Copyright
January	62	18	–	20	$298 29	$83 66	$65 00			
February	38	18	–	6	211 41	14 27	–			
March	60	18	–	21	287 15	98 43	–			
April	60	18	–	15	286 50	64 19	–			
May	32	18	–	16	177 18	69 08	30 50			
June	52	18	–	16	236 30	70 10	26 75			
September	26	14	–	14	161 02	72 99	–			
October	34	14	–	14	168 39	59 51	6 90			
November	32	14	–	1	152 79	4 81	21 25			
December	66†	14	–	23	335 21	84 23	73 25			
Total	462	164‡	–	146	$2,314 24	$621 27	$223 65	$326 69	$320 60	$10 00

* Includes $20.60 incidental expenses. † Includes 12 pages of Annual Index. ‡ Includes Advertisers' Index and any other unpaid space.

Gross cost		$3,816 45
Receipts from subscriptions, sale of JOURNALS and reprints	$211 55	
Receipts from advertising (net)	1,119 00	
		1,330 55
Net cost		$2,485 90

Report of the Library Committee, 1925–26

BOSTON, March 17, 1926.

To the Boston Society of Civil Engineers:

The Librarian submits for the Library Committee the following report for the year 1925–26.

Since the last annual report 81 bound volumes and 93 pamphlets have been added to the library. We now have about 10,500 bound volumes and 3,800 pamphlets.

During the year 411 books have been loaned to members of this Society, or to members of other societies included in the Affiliated Technical Societies of Boston, and fines amounting to $20.66 have been collected.

The following books have been contributed by authors or publishers: "Street Traffic Control," McClintock; "Sampling and Testing of Highway Materials," Barton and Doane; "Materials Testing," Cowdrey & Adams; "Practical Accounting for General Contractors," Grant; "Flow of Water in Pipes," Hiram F. Mills; and "Principles and Practice of Surveying," Volume II, Breed and Hosmer.

A complete list of books, added since the last report, is appended. The bound volumes not included in this list are mostly municipal, state and Federal reports.

The work of rearrangement and improvement of the catalogue has been continued throughout the year, $427.91 having been expended for this purpose from the Special Library Fund. A number of duplicate books were sold, and the proceeds, amounting to $130.99, were added to the Special Library Fund.

The Library Committee has studied the needs of the Library, and desires to make the following recommendations for the coming year:

(1) That a section on Building Codes be added to include building codes for Massachusetts cities, for certain other New England cities, and for several of the larger cities in the United States.

(2) That arrangements be made for collecting, and keeping readily available, data on the licensing of professional engineers in the various states throughout the country.

At the present time it is difficult to get reliable information promptly on these two subjects, and your Committee believes it would be useful to have these data available in the Society rooms.

The Committee further recommends the appointment of subcommittees in the Sections to assist the Library Committee along special lines of effort. Definite cooperation of this character would be particularly helpful, for example, in installing a Building Code section and in keeping the Committee posted on books and reports which should be added to the Library.

Respectfully submitted,

For the Library Committee,

JOHN B. BABCOCK, *Librarian.*

BOOKS ADDED TO THE LIBRARY, 1925–26

Analytic Geometry. Hopkins & Zivet.
Concrete, Plain and Reinforced. Taylor, Thompson & Smulski.
Construction Equipment, Manual, 1924. Associated General Contractors of America.

Construction of Parallel Wire Cables for Suspension Bridges. John A. Roebling's Sons Company.*
Drainage and Flood Control. George W. Pickels.
Economics of Public Utilities. L. R. Nash.
Engineering Failures and Their Lessons. Edward Godfrey.
Fatigue Study. F. B. and L. M. Gilbreth.
Flow of Water in Pipes. Hiram F. Mills.*
Fresh Air and Ventilation. C.-E. A. Winslow.
Fuels and Their Combustion. Haslam & Russell.
Materials Testing. Cowdrey & Adams.*
Port Development. R. S. MacElwee.
Practical Accounting for General Contractors. H. D. Grant.*
Practical Radio. Moyer & Wostrel.
Principles and Practice of Surveying, Vol. II. Breed & Hosmer.*
Psychology of Management. L. M. Gilbreth.
Pulverized Fuel. L. C. Harvey.
Readings and Problems in Statistical Methods. Horace Secrist.
Sampling and Testing of Highway Materials. Barton & Doane.*
Street Traffic Control. McClintock.*
Superpower. W. S. Murray.
The Public and its Utilities. W. G. Raymond.
The Executive and His Control of Men. E. B. Gowin.
Water Works Practice, 1925. American Water Works Association.

Report of Committee on Social Activities

BOSTON, March 17, 1926.

To the Boston Society of Civil Engineers:

Your Committee on Social Activities submits the following report for the year 1925–26.

Eleven hundred members and guests have been served with supper at seven monthly meetings during the past year. This makes an average of nearly 160 persons served per meeting, which is favorable in comparison with previous years, and confirms the opinion that these monthly suppers have the approval of the members of the Society.

The notable event of the year was the February meeting, when the Society again acted as hosts to the student societies of the near-by colleges. At that meeting a record number of 275 were served, exceeding the record of former years by at least 10. The number served at the remaining meetings of the year were under 200 per meeting, and consequently the members of the Committee were not unduly taxed in performing their duties. At the Affiliation Meeting in May, 180 members and guests were served.

The omission of the December meeting slightly lightened the burden for the Committee for the year. This was offset, however, by the resignation, in November, of the Chairman, Mr. Houser. On account of business reasons and personal affairs, Mr. Houser was unable to render the service required for the duties of the office. Your present Chairman has endeavored to maintain the standard set by former years.

Able assistance has been loyally rendered by the members of the Committee and

* Gift.

others of the Society. The Chairman joins with the members of the Society in expressing appreciation of their willingness in helping to carry along the work.

The Committee is also especially indebted to the Secretary of the Society for the advice and aid that he has given us during the unsettled period of the past year.

Respectfully submitted,

HUGH D. CHASE, *Chairman.*

Report of Committee on Subsoils of Boston

BOSTON, March 16, 1926.

To the Boston Society of Civil Engineers:

The Committee on Boston Subsoils wishes to report progress in its work of gathering data relative to the character and locations of subsoil in Boston and the immediate vicinity.

We have been unable to obtain copies of all boring reports made during the past year, but can say that we have obtained copies of approximately 300 since the last annual meeting, making a total of about 1,000 boring reports which have been collected from various sources and examined.

These reports have been transferred for reference to filing cards. They have been indexed and located upon maps for convenient reference. The area of the city has been divided into different parts, and we are pleased to say that there is on file at the Society rooms three sectional maps showing the locations of borings collected.

As fast as any important group of borings have been obtained and located in the areas covered by the original maps, they have been incorporated in the plans. These maps have been revised, and we believe all of them are up-to-date in this respect.

It is the belief of the Committee that the collection of these borings will make it easier for the preliminary study of Boston underground, and will ultimately permit fairly reliable contour maps to be made of the surface of the clays and glacial gravels above them.

A contour map of the rock floor under Boston has already been made, but there are certain gaps which the Committee is anxious to fill in, and we trust that when information comes to hand regarding this rock base it will be forwarded to the Committee.

In the matter of making borings, it is again desirable to urge that all borings be referenced to surface grades established by the city, as this will make the data more accurate.

The Committee has been able to aid quite a number of people in different ways, and it is understood that the maps have been studied to a considerable extent in the Society rooms. Therefore, if it pleases the Society, we believe the work of the Committee should be continued.

Respectfully submitted,

H. E. SAWTELL, *Chairman,*
For the Committee.

Report of the Executive Committee of the Sanitary Section

BOSTON, March 3, 1926.

To the Sanitary Section, Boston Society of Civil Engineers:

During the year 1925–26 six meetings of the Section were held, the subjects and speakers being as follows:

March 4, 1925. — Annual meeting. "The Sewerage Works of Framingham, Massachusetts," by Mr. F. W. Haley, Assistant Engineer, with Barbour & Dixon, illustrated; *attendance*, 45.

October 7, 1925. — Regular meeting. "Some Observations upon Sewage Treatment in England and Germany," by Mr. Almon L. Fales of Metcalf & Eddy, illustrated; *attendance*, 57.

December 2, 1925. — Regular meeting. "Hydrogen-ion Control in Chemical Treatment of Tannery Wastes," by Stuart E. Coburn, Chemist, with Metcalf & Eddy; also, "A Plant for the Degreasing of Wool Scouring Wastes," by Mr. George G. Bogren, Sanitary Engineer, with Weston & Sampson; *attendance*, 28.

January 6, 1926. — Special meeting. "The Sanitary Conservation and Utilization of Water Resources," by Mr. W. L. Stevenson, Chief Engineer, Pennsylvania Department of Health, and Secretary of the Pennsylvania Sanitary Water Board; *attendance*, 57.

January 27, 1926. — Special meeting, held jointly with Main Society. "The Engineer and Public Health," by Dr. George E. Vincent, President of the Rockefeller Foundation; *attendance*, 120.

February 3, 1926. — Special meeting. "Chlorination of Water and Sewage," by Prof. Earle B. Phelps of the College of Physicians and Surgeons, Columbia University; *attendance*, 39.

Six papers or addresses presented at the Section meetings have been or will be published in the JOURNAL of the Society.

The custom of meeting for dinner prior to the meeting of the Section has been revived and has proved to be a very desirable feature. During the year the attendance at these dinners has averaged 25.

The Executive Committee has held six meetings during the year.

Excursions. — Arrangements were made for two excursions to be held during the summer recess. An excursion to the Lawrence Experiment Station of the Massachusetts Department of Public Health was planned for Saturday afternoon, June 6, but it was found advisable to cancel this excursion on account of unfavorable weather and the small number who had signified their intention to attend. On Saturday afternoon, September 19, about 15 members of the Section went by automobile to visit the sewage treatment works at Framingham and Worcester, Massachusetts.

Amendments to By-Laws. — At the regular meeting, December 2, 1925, it was voted to amend the By-Laws of the Section so that Article 6, Section 3 would read, "The regular meetings of the Section shall be held on the first Wednesday of the months of March, June, October and December unless otherwise authorized by the Executive Committee." This amendment has been approved by the Board of Government.

Special Committees. — There is now one special committee of the Section investigating the matter of Garbage Collection and Disposal. During the year this committee has made one progress report.

Membership. — The records of the Secretary of the Society now show a total membership of 228 for the Sanitary Section. During the year there have been 23 new members enrolled in the Section, two members — Mr. Leonard Metcalf and Mr. G. E.

Loefquist — have died, and two members have retired from the Section, making the net gain in membership 19.

Attendance. — The attendance at meetings during the year has ranged from a minimum of 28 to a maximum of 120, and for the six meetings there has been a total attendance of 346, or an average of about 58 per meeting.

Respectfully submitted,

For the Executive Committee,

R. W. Horne, *Clerk.*

Report of the Executive Committee of the Designers Section

Boston, March 10, 1926.

To the Designers Section, Boston Society of Civil Engineers:

Seven regular meetings of the Designers Section have been held and one regular meeting has been postponed during the past year. A summary of the meetings is as follows:

March 11, 1925. — *Subject,* "Reconstruction of Harvard Bridge;" *speaker,* Lewis E. Moore, Consulting Engineer; *attendance,* 49.

April 8, 1925. — *Subject,* "The New Water Supply of the City of Providence;" *speaker,* Frank E. Winsor, Chief Engineer of the Water Supply Board of the city of Providence; *attendance,* 38.

May 13, 1925. — *Subject,* "The Engineer Takes Wings;" *speaker,* Charles M. Emerson, New England Manager of the Fairchild Aerial Surveys, Inc.; *attendance,* 31.

October 14, 1925. — *Subject,* "The Theory versus Practice in Concrete Construction;" *speaker,* R. K. Hallock of the Aberthaw Company; *attendance,* 50.

November 11, 1925. — *Subject,* "The Wells River and Woodsville Bridge;" *speakers,* C. R. Perry and Kendall Woodrough of J. R. Worcester & Co.; *attendance,* 50.

December 9, 1925. — *Subject,* "Fundamentals of Mass Form and Proportion;" *speaker,* C. Howard Walker of Walker-Walker & Kingsbury; *attendance,* 48.

January 12, 1926. — *Subject,* "Stresses in a Composite Member subjected to Bending and Direct Stress;" *speakers,* B. A. Rich and W. W. Bigelow of Rich, Bigelow & Tirrell; also *subject,* "The Effect of 'Cal' on Cement and Concrete;" *speaker,* M. N. Clair of The Thompson-Lichtner Company; *attendance,* 65.

February 10, 1926. — Meeting postponed on account of storm. *Subject,* "Field Control of Concrete;" *speaker,* W. C. Voss of the Portland Cement Association.

The average attendance at meetings held during the year was 47.

Forty-five names have been added to the Designers Section, one name has been dropped and one member died, giving a net gain of 43; leaving the membership at 179.

It has been the policy during this season to endeavor to obtain outside speakers of authority on a wide range of subjects affecting design. Effort has been made to have a larger number of papers by members of the Section, but due to the difficulty of getting such papers and the necessity of planning ahead for outside speakers, only two papers by members of the Section have been presented. Another is scheduled for the April meeting. The Executive Committee believes that everything possible should be done to encourage the preparation of papers by Section members and the submission of them for presentation, but that the setting aside of one meeting for Section papers is to be avoided.

The Executive Committee submits as a suggestion to the Board that in recognition of the distinction of having been awarded a prize for a paper presented to the Society, a distinctive letter or mark for each such award be placed in the year book beside the names of members having won prizes.

For the Executive Committee,

Scott Keith, *Clerk.*

Report of the Executive Committee of the Highway Section

Boston, March 1, 1926.

To the Highway Section, Boston Society of Civil Engineers:

During the past year three meetings of the Highway Section have been held, as follows:

February 25, 1925. — Election of officers.

September 17, 1925. — Inspection trip to the Canton-Stoughton project. This road is of the Dual Type of construction, and the first to be built by the Massachusetts Department of Public Works.

December 3, 1925. — Mr. Day Baker, of the Motor Coach Association, spoke on the Development of Highway Bus Transportation in Massachusetts.

During the year the Highway Section has lost three members and has added five new members, making the present membership 58.

Respectfully submitted,

For the Executive Committee,

H. F. MacWilliams, *Clerk.*

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FOUNDED 1848

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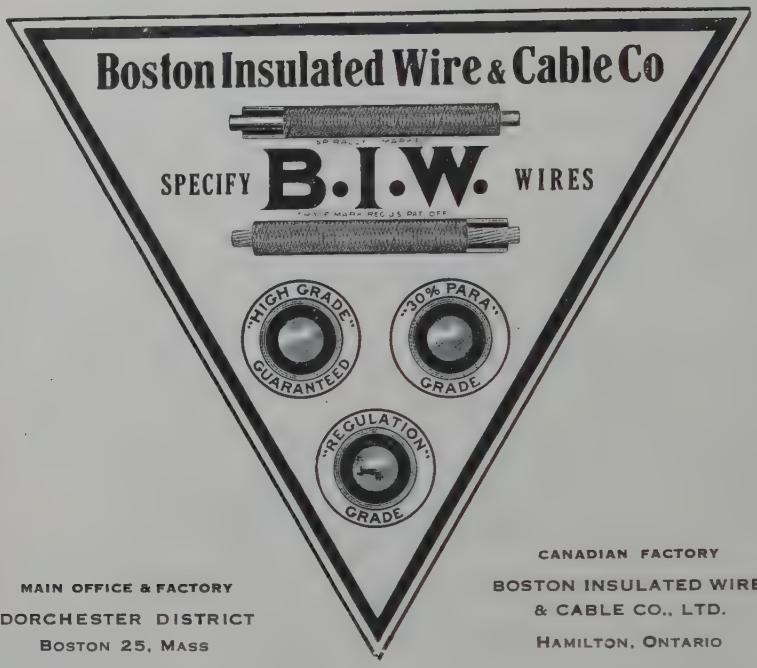

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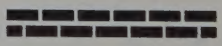

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